

2012 L.G. Hanscom Field

ESPR

Environmental Status & Planning Report

Bedford, Massachusetts • EEA Number: 5484/8696 • December 2013



Massachusetts Port Authority
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December 31, 2013

Secretary Richard K. Sullivan, Jr.
Executive Office of Energy and Environmental Affairs
Attn: MEPA Office, EEA 5484/8696
100 Cambridge Street, Suite 900
Boston, MA 02114

Re: 2012 L.G. Hanscom Field Environmental Status and Planning Report (ESPR)

Dear Secretary Sullivan and Director Buckley:


The Massachusetts Port Authority (Massport) is pleased to submit for your review this 2012 L.G. Hanscom Field Environmental Status and Planning Report (*2012 ESPR*) (EEA #5484/8696). The *2012 ESPR* is being submitted in accordance with the provisions of the Massachusetts Environmental Policy Act (MEPA), G.L. Chapter 30, Sections 62-62H and its implementing regulations, 301 Code of Massachusetts Regulations (CMR) 11.00. The *2012 ESPR* responds to your May 18, 2012, Certificate on the Proposed Scope for the *2012 ESPR*.

Massport is requesting an extension of the public comment period to approximately 60 days with the close of public comments on March 11, 2014. The MEPA consultation session is tentatively scheduled for March 3, 2014 at 5pm in the Civil Air Terminal (first floor) at Hanscom Field. Massport will also be presenting the *2012 ESPR* at the monthly meeting of the Hanscom Area Town Selectmen (HATS) meeting on February 27, 2014 at 7pm at the Bedford Town Hall. Three additional technical meetings are scheduled for 6:00pm on January 29, February 5, and February 11, 2014 in the Civil Air Terminal (first floor) at Hanscom Field.

Members of Massport staff are available to discuss the attached document with you at your earliest convenience. Please contact Thomas Ennis at 617-568-3546 or ennis@massport.com with any questions or comments.

Sincerely,

Massachusetts Port Authority



Stewart Dalzell, Deputy Director
Environmental Planning and Permitting

Enclosures

2012 L.G. Hanscom Field

Environmental Status and Planning Report

Bedford, Massachusetts

EEA NUMBER: 5484/8696

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1 Introduction / Executive Summary

1.1 Environmental Status and Planning Report

The Massachusetts Port Authority (Massport) has filed this Environmental Status and Planning Report (ESPR) for calendar year 2012, in compliance with Massachusetts Environmental Policy Act (MEPA), to provide a status report on activity levels and environmental conditions at Laurence G. Hanscom Field (Hanscom). The Secretary of the Executive Office of Energy and Environmental Affairs (EEA) defined the scope for the *2012 ESPR* in a Certificate issued May 18, 2012.

This ESPR reports on current conditions at Hanscom Field and compares them to historical data from the *2000* and *2005 ESPRs* and other available sources as described in each chapter. The *2012 ESPR* informs future planning by presenting and evaluating the potential cumulative environmental effects of future scenarios for the planning years of 2020 and 2030 based on forecasts of airport activity levels. The 2020 and 2030 scenarios represent estimates of what *could* occur (not what *will* occur) in the future using certain planning assumptions, but are not necessarily recommended outcomes. The future scenarios are consistent with Massport's 1978 Master Plan and 1980 Regulations for Hanscom Field, which prohibit scheduled commercial passenger services with aircraft having more than 60 seats.

The retrospective and prospective information presented in this ESPR provide a planning tool for assessing and reviewing changes at Hanscom Field and its environs over time. The aviation activity forecasts in the *2012 ESPR* account for a realistic level of aviation growth based on local and national aviation trends and forecasts from the Federal Aviation Administration's (FAA) New England Regional Aviation System Plan (NERASP). Additionally, the *2012 ESPR* provides a database and regional planning tool for the Towns of Bedford, Concord, Lexington, and Lincoln, as well as State agencies and other interested parties. Figure 1-1 shows the location of Hanscom on the USGS map.

EEA #5484/8696

Submitted by:

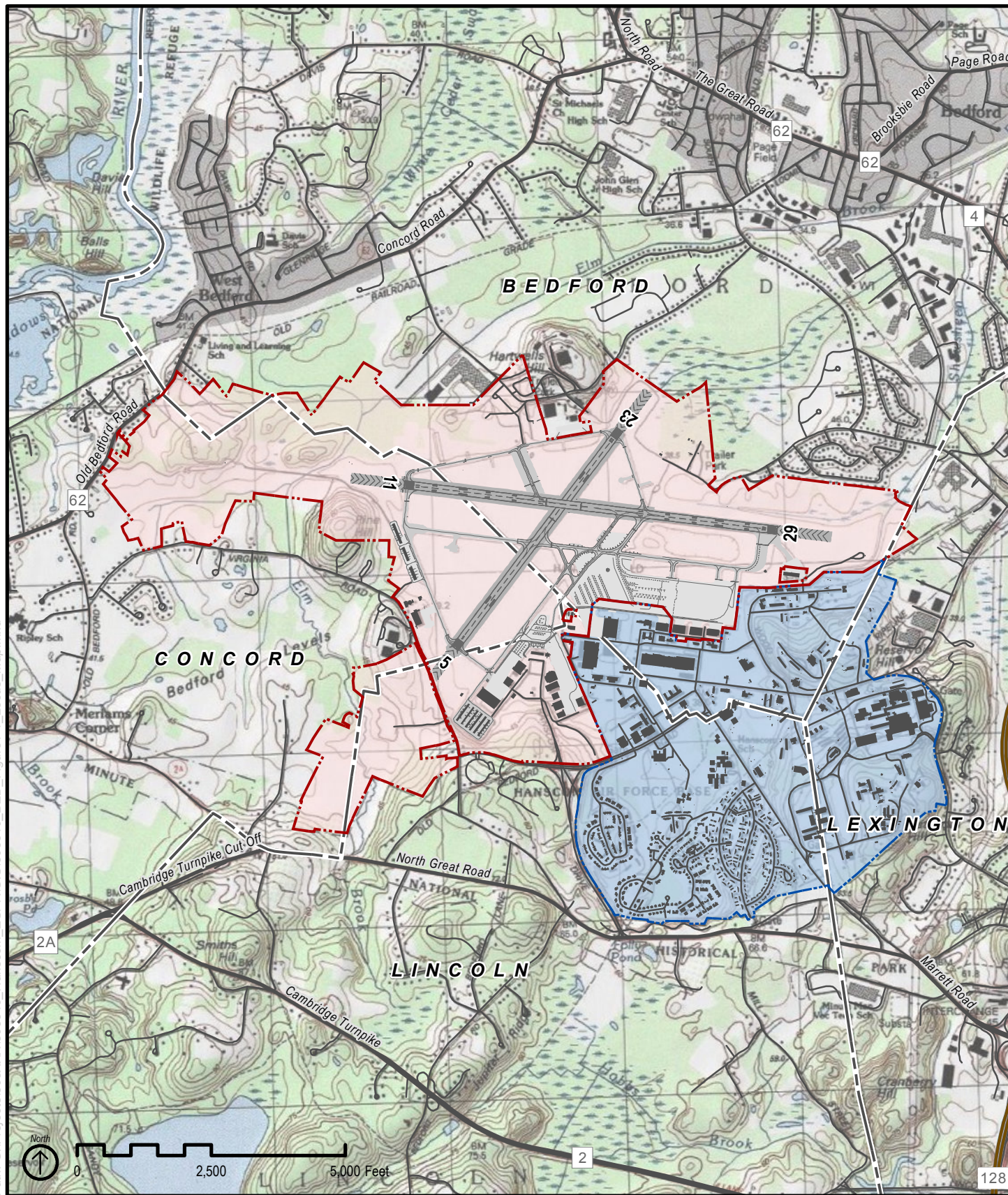
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- Hanscom Field Property Boundary
- Hanscom AFB Property Boundary
- Municipal Boundary



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Locus Map

This introduction to the 2012 *ESPR* provides background information on Hanscom Field, describes the environmental review process, identifies the analytical framework for the *ESPR*, and summarizes the primary changes since 2005, and provides the organization for the report.

1.2 Hanscom Field

Hanscom Field is New England's premier, full-service general aviation (GA) airport and serves as a GA reliever for Boston Logan International Airport with limited commercial passenger service. It is located approximately 20 miles northwest of Boston, comprising approximately 1,300 acres of land, in close proximity to Minute Man National Historical Park (MMNHP) and Great Meadows National Wildlife Refuge (GMNWR). Hanscom lies just outside Route 128/I-95, and is convenient to most of metropolitan Boston. Route 2A serves as a primary commuter route and the primary access route to the airport, Hanscom Air Force Base (AFB), and MMNHP. Figure 1-2 provides the site location of Hanscom Field in relation to these roads and its boundaries with MMNHP and GMNWR.

Hanscom Field is located in parts of four different municipalities: Bedford, Concord, Lexington, and Lincoln. To the south, it abuts the MMNHP, which comprises over 900 acres. The 800-acre Hanscom AFB adjoins Hanscom to the south. GMNWR, which includes 3,600 acres along the Concord and Sudbury Rivers, is located to the west of Hanscom Field. These large land holdings provide a buffer between Hanscom Field and residential areas. Despite its proximity to these many public recreational areas and adjacent communities, the airport is visible from few locations due to its position in a low, flat area in the landscape.

The FAA identifies Hanscom Field as a reliever airport. As such, its primary role in the regional aviation system is to accommodate regional GA needs, while providing supplemental commercial and cargo service to meet small-scale, niche demands. This allows larger nearby airports to concentrate on large-scale commercial and cargo activity.

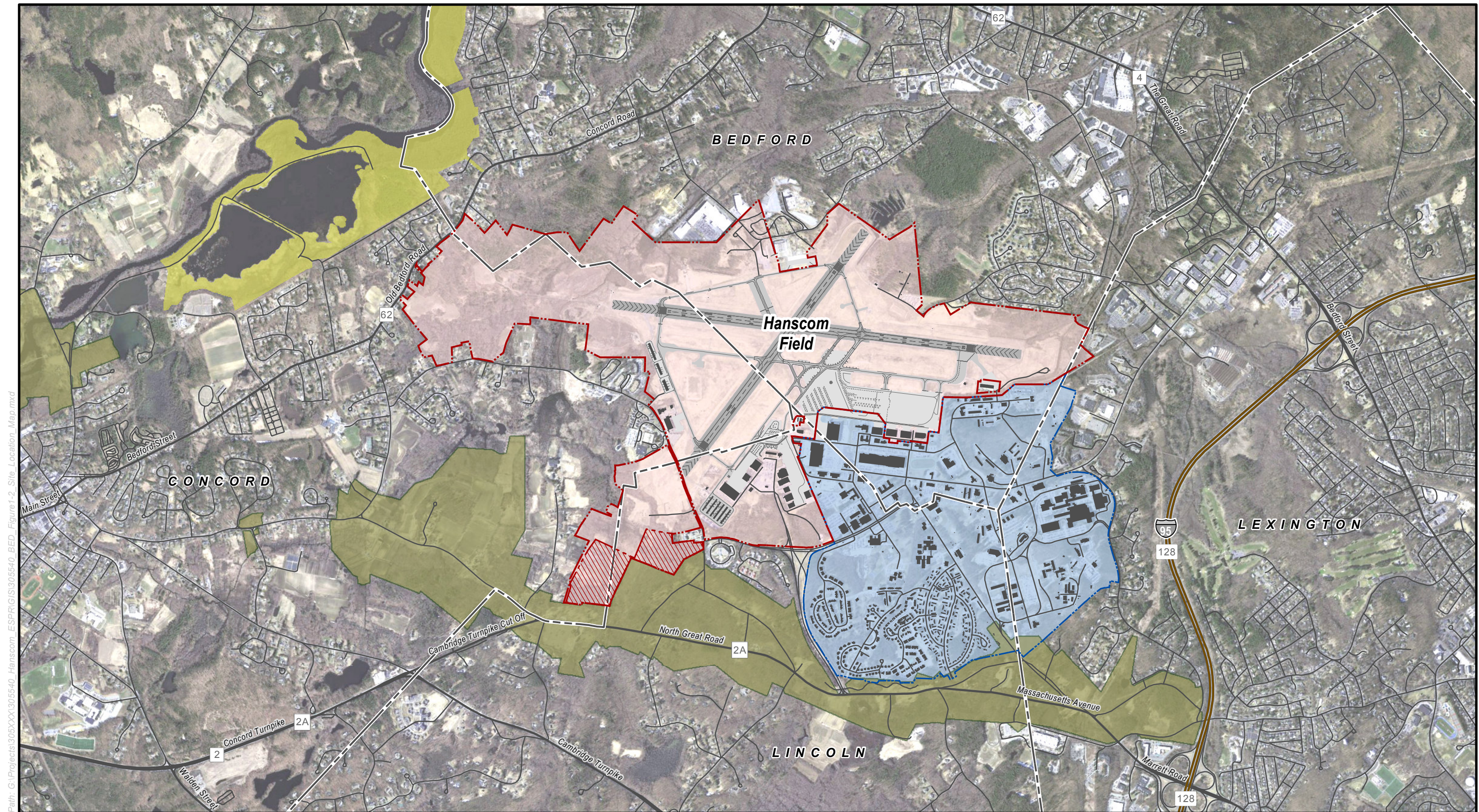
Massport assumed ownership of Hanscom Field in 1974 and prepared a Master Plan for the airport in 1978, which included a comprehensive public outreach process. In 1980, after additional stakeholder engagement, Massport adopted the Hanscom Field Noise Rules (740 CMR 25.00), which were an important outgrowth of the Master Plan. The Master Plan and the 1980 Noise Rules remain the framework for airport planning and operations today.

The variety of aviation activities at Hanscom Field include private and corporate aviation, recreational flights, pilot training, air charter, cargo, commuter service, and limited military use. The Master Plan and 1980 Noise Rules contemplated and provided for commercial airline service specifically allowing for commercial passenger aircraft with 60 seats or fewer. Commercial airlines have operated periodically at Hanscom Field since the mid-1970s. Pan Am was the most recent airline to provide commercial passenger services and Streamline Air provided scheduled charter service until September 2012.

In 1970, four years before Massport assumed operation of Hanscom Field, airport activity peaked at slightly more than 300,000 total annual aircraft operations. By 2000, operations at Hanscom Field had decreased to 212,400, with GA representing 96 percent of total activity, scheduled commercial passenger service accounting for three percent, and military at less than one percent.

Hanscom's total aircraft operations have declined by 2 percent annually since 2000, down from approximately 218,000 operations in 2000 to 166,000 operations in 2012. The number of scheduled commercial air passengers decreased from a historic high of 162,100 in 2000 to 8,609 in 2012.

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- | | | | | | |
|--|---|--|----------------|--|------------|
| | Hanscom Field Property Boundary | | MMNHP Boundary | | Interstate |
| | Massport Property within MMNHP Congressional Boundary | | Great Meadows | | Highway |
| | Hanscom AFB Property Boundary | | | | Road |
| | Municipal Boundary | | | | |



Hanscom Field 2012 ESPR

Bedford, Concord, Lexington, Lincoln, Massachusetts

Site Location Map

Data Sources: ESRI (USGS Topographic Maps), March 4, 2013; MassGIS (Community Boundaries), March 5, 2013; PAL, Inc. (Noise Sensitive Receptors), August 28, 2013

Figure 1-2

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Likewise, scheduled commercial aircraft operations have decreased from 6,600 in 2000 to 635 in 2012. GA now accounts for 99 percent of all operations. The overall decrease in activity at Hanscom mirrors long-term national trends in aviation use and fleet mix change

Despite these trends, Hanscom Field continues to play an important role as a regional transportation asset that is linked to the economic health of the region. This is reflected in the expanding market for corporate aviation. Business jet operations at Hanscom have increased 27 percent from 2000-2012 possibly indicating sustained growth in that sector.

1.3 Hanscom Field Environmental Review Process

Since 1985, the Massachusetts Secretary of the Executive Office of Energy and Environmental Affairs (EEA) has requested that Massport prepare an ESPR every five years, in order to evaluate the cumulative effect of growth and change at Hanscom Field and provide data and analyses on noise, ground transportation, air quality, and water quality. The original *1985 GEIR* (Generic Environmental Impact Report), the *1995 GEIR* Update, the *2000 ESPR*, the *2005 ESPR*, and now the *2012 ESPR* provide a retrospective analysis of the environmental effects of Hanscom Field while including analyses for future conditions. With the EEA Secretary's approval, the current ESPR was deferred until analysis year 2012 due to the economic recession of 2008-09 and respective decline in the number of aviation operations, which have remained well below the 2005 and future analysis years (see Appendix A). The role of the ESPR and relationship to project-specific environmental review is described below.

1.3.1 Role of the ESPR as an Airport-wide Review

Environmental review of Hanscom Field activities is undertaken at the state level through the ESPR process, which provides a public forum to assess the cumulative environmental effects of airport operations and informs Massport and the community regarding the implications of those environmental effects. The ESPR presents an overview of the operational environment and planning status of Hanscom Field and long-range projections of environmental conditions against which the effects of future individual projects can be compared. It allows the reader to see past and current environmental information, and a forecast of potential future environmental effects at Hanscom Field based on realistic changes in activity levels.

The ESPR is an important tool in early public engagement for future development activities. It provides a list and description of capital projects that may be undertaken or supported by Massport within the timeframes of the 2020 and 2030 scenarios. Additionally, the ESPRs are a comprehensive source of technical data and planning information for use by the towns of Bedford, Concord, Lexington, and Lincoln, State agencies and other interested parties. The ESPR does not replace the requirement for filing an Environmental Notification Form (ENF) for a specific project that meets or exceeds a MEPA regulation threshold.

1.3.2 Project-Specific Review

While the ESPRs are an important part of the regulatory process, environmental review must also be undertaken on a project-specific basis, as indicated in the EEA Certificate for the *2012 ESPR*:

The ESPR does not replace the MEPA review of specific projects at Hanscom that meet or exceed regulatory thresholds, with the exception of routine maintenance and replacement projects. For each project-specific review, Massport would be required to perform an individual analysis of impacts and mitigation (for those projects that require a stand-alone EIR and Section 61 Findings).

The ESPR serves as a vehicle for ensuring that the long-term, broad-scope planning informs the review and implementation of individual actions at Hanscom Field.

In cases where the state environmental review thresholds are triggered, Massport or the project proponent will prepare the appropriate environmental filing, including an ENF or, for projects of significant scale requiring more extensive MEPA review, an Environmental Impact Report (EIR). Where National Environmental Policy Act (NEPA) environmental review thresholds are triggered at the federal level, projects typically are also reviewed under the NEPA environmental review process with the FAA acting as the lead federal agency responsible for NEPA compliance. Both MEPA and NEPA review processes include opportunities for public comment. For example, the Runway 5/23 Safety Area Improvements project required subsequent review under MEPA and NEPA, with a Final Environmental Impact Report (FEIR) Certificate issued on March 15, 2007.

Massport also meets monthly with the Hanscom Field Advisory Commission (HFAC) to review activities at Hanscom Field. HFAC was established by an act of the state legislature in 1980 and includes 16 members appointed by constituent groups and approved by the selectmen from the four host municipalities. HFAC includes representatives from the towns of Bedford, Concord, Lexington, and Lincoln; local citizens groups; other area towns affected by Hanscom Field; businesses basing aircraft at Hanscom Field; aviation or aviation-related businesses at Hanscom Field; and business aviation and/or general aviation organizations. The HFAC process provides an opportunity to review projects that are not subject to formal MEPA review.

1.4 Development of the 2012 ESPR

Massport filed the *2005 ESPR* in November 2006 and the Secretary issued the MEPA Certificate on March 29, 2007, which determined that the *2005 ESPR* “adequately and properly complies with the Massachusetts Environmental Policy Act.” The Secretary’s Certificate requires that the major areas of analyses for the next ESPR include, but are not limited to, aviation planning, landside planning, ground access, noise, air quality, water quality, cultural and historical resources, sustainability and airport mitigation.

Using the 2007 Certificate as a starting point, Massport filed a proposed scope for the *2012 ESPR* with MEPA on February 28, 2012 and MEPA published notice of the proposed scope in the March 7, 2012 edition of the “Environmental Monitor.” After an extended public comment period which included scoping meetings at the Lexington Town Hall on March 20th and Bedford Town Hall on April 4th, the Secretary issued the scope for the *2012 ESPR* in its Certificate on May 18, 2012.

The *2012 ESPR* follows the general outline of the *2005 ESPR*. The *2005 ESPR* was initially filed as a Draft ESPR in accordance with the MEPA Scope. Since there were limited comments on the 2005 Draft ESPR, the document was re-noticed as the Final ESPR. Based on this experience, Massport proposed and EEA agreed that a single ESPR is now appropriate given that Massport also prepares and circulates the “Annual Noise Report” and the “State of Hanscom” every year to the public. A single ESPR volume is consistent with the ESPR process for Boston Logan International Airport (EEA #3247).

Detailed ESPR technical studies are summarized in a readable format to illustrate clearly the implications of recent trends, existing conditions and potential future scenarios. The ESPR builds on the base information developed for the *2005 ESPR*, presenting policy considerations and an overview of the airport’s current and potential future role within the regional planning context, including a status report on Massport’s proposed planning initiatives and projects. The *2012 ESPR* technical studies include analysis

of airport activity levels, ground access, noise, air quality, water quality, natural resources, cultural and historical resources, and sustainability.

This section outlines the enhancements to the technical analysis since the *2005 ESR*, describes the outreach program for the development of the *2012 ESR*, and provides a schedule for the *2012 ESR* public review and comment.

1.4.1 Technical Analysis and Data Gathering for the 2012 ESR

Massport has responded to the Secretary's Certificate and prepared a detailed study of existing and projected future conditions at Hanscom. The *2012 ESR* includes a comprehensive analysis of information collected over the past three *ESRs* to show important trends in Hanscom and regional activities and the associated trends in environmental conditions over that time.

The preparation of single forecast scenarios for the two planning years (2020 and 2030) based on realistic development assumptions provides a practical and effective way to evaluate potential future environmental effects and avoids confusion with the previously reviewed high and moderate growth conditions. The *2012 ESR* updates several of the comprehensive studies undertaken in 2005, including the reconnaissance level survey of historic and archeological resources, detailed field measurements of traffic conditions, and quantification of acreage and linear miles of cultural, historical and recreational resources within the 65 and 55 dBA Day-Night Sound Level (DNL) contours. Commuter surveys and parking lot occupancy assessments were also repeated providing for comparisons over time.

Issues that are addressed in the *2012 ESR* include airport facilities and infrastructure; aviation activity levels; airport planning; regional transportation context; ground transportation; noise; air quality; wetlands, wildlife, and water resources; historical and cultural resources; sustainability; and summary of potential beneficial measures. Technical appendices are provided with responses to comments on the proposed *2012 ESR* Scope and supportive material for the technical studies.

1.4.2 Outreach for Preparation of the 2012 ESR

In addition to the MEPA scoping process, Massport engaged with state, regional and local agencies and commissions in the preparation of the *2012 ESR*. Massport met with a variety of groups to review the scope and methodologies, solicit information for inclusion, and identify the need for additional studies. Many others were contacted by phone.

Massport sent letters to each of the local Historic Commissions and then made a presentation at one of their regularly scheduled public meetings where the *2012 ESR* planning effort was described and input solicited. Specifically, each commission was asked to discuss any updates to historic resources since 2005 that should be included in the *2012 ESR*. This information has been incorporated into Chapter 10 Cultural and Historical Resources.

Massport also sent letters to each of the Town Planners informing them of the *2012 ESR* and requesting information about planned development and infrastructure projects, the status of their long-range comprehensive plans and changes in conservation and recreational land. Follow-up calls were made to each of the planning offices to discuss the material and ensure a comprehensive amount of input. This information has been incorporated in Chapter 4 Airport Planning, Chapter 6 Ground Transportation, and Chapter 10 Cultural and Historical Resources.

MMNHP staff reviewed existing material about the Park and provided updates. Staff from the Hanscom AFB cooperated on efforts to minimize single occupancy automobile travel. Table 1-1 provides a list of

all outreach meetings conducted by Massport for the 2012 ESPR.

Table 1-1 2012 ESPR Outreach Meetings

Category	Meeting	Date
Federal Agencies	National Park Service	May 23, 2013
State Agencies	MassDOT, MassRides	October 10, 2013
Town Planning Departments	Letters and Telephone correspondence	March-June 2013
Historic Commissions	Bedford Historic Preservation Commission	January 7, 2013
	Concord Historic Commission	December 13, 2012
	Lexington Historic Commission	January 10, 2013
	Lincoln Historic Commission	February 5, 2013
Others	Hanscom Field Tenants	December 18, 2012
	Hanscom AFB	September 19, 2013

1.4.3 Environmental Review Schedule

The environmental review schedule provides several opportunities beyond those required by the MEPA process for the public to learn about activities at Hanscom both today and in the future. The public comment schedule for this *2012 ESPR* is as follows:

- Massport filed the *2012 ESPR* with the EEA, MEPA Office on December 31, 2013. Notice was published in the Environmental Monitor on January 8, 2014.
- Massport has requested an extension of the required 30-day public comment period to 60 days, with the comment period ending on March 10, 2014. The Secretary's Certificate is anticipated to be issued approximately one week later.
- A MEPA consultation meeting will be scheduled specifically for MEPA to solicit public comments on the ESPR.
- The ESPR will be presented at the monthly Hanscom Area Town Selectmen (HATS) meeting in January during the MEPA comment period.
- In addition, three public presentations will be scheduled prior to the close of comments to provide greater detail on each of the technical topic areas addressed in the *2012 ESPR*.

1.5 Primary Findings of the 2012 ESPR

The following section provides a summary of the key *2012 ESPR* findings, corresponding with the subject matter of each chapter.

Airport Facilities and Infrastructure

Since the *2005 ESPR*, Massport has made key improvements to fundamental airport infrastructure at Hanscom Field and third-party developers have upgraded corporate aviation facilities. The following is a list of significant projects and activities completed since 2005:

- Runway Safety Area (RSA) improvements at Runway Ends 5 and 23 including grading of the RSA and wetland replication to meet federally-mandated airfield safety standards (2008)
- RSA improvements at the end of Runway 11 by relocating portions of the perimeter road (2012)
- Reconstruction of the western end of Taxiway E, Taxiway G, and Taxiway M (2009)
- Redevelopment of the Hangar 24 site for a Fixed Base Operator (FBO) facility by Rectrix Aviation, a project which is nearing completion at this time
- Removal of fuel storage tanks at Hangar 10 (2011)

- Implementation of enhanced access control system and replacement of a portion of the perimeter fence (2012)
- Relocation of portions of the perimeter road at the approach to Runway 29 (2012)
- Ongoing airfield maintenance
- Ongoing vegetation removal and maintenance

Due to a decrease in airport activity levels, most of the projects undertaken were primarily associated with updating and maintaining existing infrastructure. The ongoing redevelopment of hangar/FBO space by Rectrix Aviation is representative of the persistent demand for business aviation use of the airfield.

Since the 2005 *ESPR*, there has been no increase in impervious surface. Additionally, there have been no significant changes in the utility systems or in the parking spaces inventoried in the 2005 *ESPR*.

Airport Activity Levels

In 2012, Hanscom Field accommodated approximately 166,000 aircraft operations, with GA accounting for 99 percent and commercial and military operations accounting for the remainder. Nearly three-quarters (73 percent) of the operations performed at Hanscom in 2012 were in single-engine piston (SEP) aircraft, consisting primarily of training operations and recreational (or personal) flying. Training at two flight schools at Hanscom is the prevailing type of aircraft operation at Hanscom Field.

Hanscom also serves the needs of business aviation users, including corporations that own their own aircraft and businesses that charter private flights. Business aviation operations conducted in jets, turboprops, and multi-engine piston aircraft accounted for 22 percent of Hanscom's activity. Streamline Air offered regularly scheduled commercial passenger services at Hanscom from April 2011 to September 2012 primarily serving business travelers. No scheduled commercial flights have operated at Hanscom Field since September 13, 2012.

Hanscom's total aircraft operations have declined by 2.0 percent annually since 2000, from approximately 218,000 operations in 2000 to 166,000 operations in 2012. The drop in operations at Hanscom mirrors a long-term decline in GA activity in the U.S, due rising fuel prices and the economic recession of 2008-09. Nationally, the GA industry has yet to recover from the downturn. GA operations at U.S. airports with air traffic control towers were down by nearly 7 percent in 2012 compared to 2009. However, GA at Hanscom Field has recovered with operations increasing by approximately 11 percent over the same period. Business aviation has been the fastest growing segment of activity at Hanscom Field, increasing at a long-term average annual rate of 2 percent from 2000 to 2012. After a sharp decline in business aviation following the economic recession of 2008-09, business operations have been slow to recover due to the sluggish pace of economic growth and fiscal uncertainty. Yet, investment commitments from the FBOs suggest a strong future market for business aviation at Hanscom.

Total aircraft operations are forecast at 168,300 in 2020 and 193,100 in 2030. Long-term growth in overall aircraft operations is expected to be modest at 0.8 percent per year from 2012 to 2030. Consistent with a positive outlook for business aviation nationally, total business-related operations are expected to increase by 2.9 percent per year reaching nearly 60,000 operations in 2030. The subset of business jet operations are forecast to grow by 3.4 percent per year to nearly 46,800 in 2030. Table 1-2 presents actual 2005 and 2012 aviation activity levels (7:00 am to 11:00 pm) by aircraft type to illustrate recent trends and then activity levels forecasted for the planning years of 2020 and 2030.

Table 1-2 Summary of Actual and Forecast Activity Levels at Hanscom Field

	Actual 2005	Actual 2012	Forecast	
			2020	2030
Aircraft Operations (7:00 am to 11:00 pm)				
General Aviation				
Local (SEP)	58,535	70,196	62,605	65,164
Personal Flying (SEP)	57,894	51,477	50,661	58,285
Business Non-Jet (MEP + Turbo)	9,646	10,178	10,861	12,985
Business Jet	32,345	25,638	35,043	46,782
Helicopter	7,004	7,345	7,345	7,345
Subtotal GA	165,424	164,834	166,515	190,561
Military	904	745	745	745
Commercial Scheduled Airline¹	3,627	635	1,040	1,820
Total Operations	169,955	166,214	168,300	193,126
Based Aircraft	387	340	360	416
Commercial Airline Passengers	17,457	8,609	20,280	40,600
Notes:				
1. Aircraft operations are tracked by the FAA daily between 7:00 am and 11:00 pm, which are the hours that the air traffic control tower is open.				

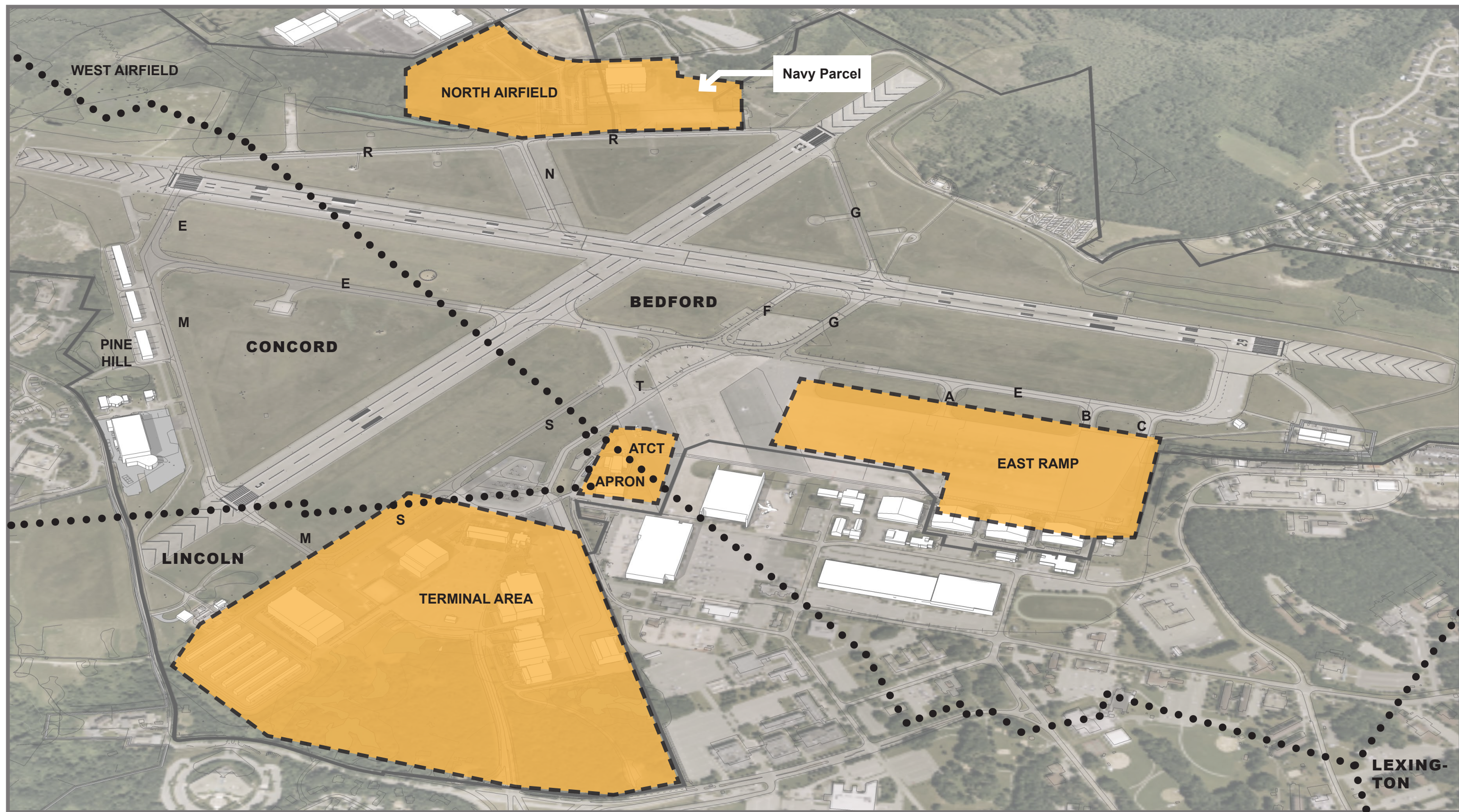
Source: Massport and FAA Tower Counts

Airport Planning

The airport planning section of the 2012 *ESPR* includes an assessment of the adequacy of existing facilities to support safe aviation activity and an evaluation of improvements necessary to support anticipated future aircraft activity levels. It also considers Hanscom's future role in the regional transportation network, recent and expected near-future trends in the industry, and other conditions that will support a sustainable aviation business. Planning for Hanscom Field is based on the airport activity levels that have been forecast for the 2020 and 2030 planning scenarios. The planning concepts take into account the 1978 Master Plan and Massport's 1980 Regulations, which establish the general planning framework for Hanscom Field. Detailed environmental analysis would occur for projects that move from conceptual screening to the proposal stage when those projects exceed MEPA or NEPA review thresholds.

This *ESPR* assesses current planning initiatives and projects at Hanscom Field, and compatible development consistent with activity forecasts for the 2020 and 2030 planning scenarios. If fully implemented, the plans included in the 2020 scenarios would create approximately 9 acres of new impervious surface as compared to 2012 (2 acres at the Terminal Area and 7 acres in the North Airfield). By comparison, if fully implemented, the 2030 scenarios would create approximately 19 acres of new impervious surface as compared to 2012 (10 acres at the Terminal Area and 9 acres in the North Airfield). Where new construction is proposed, Massport will consider opportunities to remove existing pavement to achieve its goal of no net gain in impervious surfaces. These impervious surface estimates are for planning purposes only and measures would be taken to minimize or offset any potential increases in impervious surfaces.

Figure 1-3 depicts the possible location of planning initiatives and concepts in the 2020 and 2030 scenarios. Table 1-3 summarizes the current planning initiatives and projects at Hanscom Field,



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supporting Hanscom Field's role as a premier full-service GA airport. Massport has identified appropriate environmental management approaches to achieve consistency with the local and regional plans.

Table 1-3 Potential Planning Concepts under the 2020 and 2030 Scenarios

Planning Area	2020 Scenarios ¹	2030 Scenarios ²
Terminal Area	<ul style="list-style-type: none"> Replacement hangars with associated support facilities and a new access road Replacement of salt storage/maintenance facility First phase of Air & Space Museum for the Massachusetts Aviation Historical Society Civil Air Terminal enhancements 	<ul style="list-style-type: none"> Second phase of Air & Space Museum GA hangars with associated support facilities Hotel Civil Air Terminal enhancements New and replacement structured public parking spaces as needed
Air Traffic Control Tower (ATCT) Apron	<ul style="list-style-type: none"> Addition to the airport maintenance facility Relocation option for US customs facility 	<ul style="list-style-type: none"> Addition to the airport maintenance facility GA hangar development Alternative landside access
East Ramp	<ul style="list-style-type: none"> GA hangars with associated support facilities Alternative landside access Relocation option for US customs facility 	<ul style="list-style-type: none"> GA facilities and replacement of existing GA hangars Alternative landside access
North Airfield	<ul style="list-style-type: none"> GA hangars with associated support facilities on existing Massport property as well as on land expected to be obtained from the Navy 	<ul style="list-style-type: none"> GA facilities on existing Massport property as well as on land expected to be obtained from the Navy
Note: The Pine Hill and West Airfield areas are referenced in this ESPR for consistency with past ESPRs. No new development has been evaluated for the 2012 ESPR. The 2005 planning concepts can be considered current. 1. 2020 includes potential activities in 2013 through 2020. 2. 2030 includes potential activities in 2021 through 2030 and planning concepts from the 2020 scenarios.		

Regional Transportation Context

Massport advocates a multi-modal regional transportation policy to improve the efficient use of the region's transportation infrastructure by appropriate expanded use of regional airports and alternative transportation modes. For more than a decade, Massport has formed partnerships with federal, state, and regional agencies to expand and improve inter-city travel options for the New England region by supporting an integrated, multi-modal, regional transportation network.

Within this context, Massport is committed to maintaining Hanscom Field as a vital transportation resource within the regional airport system. Because of its proximity to Boston and Route 128 area businesses that rely on corporate aviation, Hanscom Field handles about 166,000 annual GA operations, more GA activity than any other GA or commercial service airport in the region. Hanscom Field will continue to function within the regional airport network primarily as a GA reliever for Logan Airport with a limited role as a commercial air service airport.

Table 1-4 GA Operations at Airports in the Boston Metropolitan Area

Airport ¹	Primary Aviation Service	GA Operations ²		Average Annual Growth	Percent Local ³	Based Aircraft ³
		2005	2012			
Hanscom Field	General Aviation	165,424	164,835	-0.1%	42.3%	340
Norwood Municipal	General Aviation	70,496	68,405	-0.4%	51.9%	160
Beverly Municipal	General Aviation	64,110	58,203	-1.4%	54.9%	98
Nashua/Boire Field	General Aviation	127,573	55,620	-11.2%	53.2%	324
Lawrence Municipal	General Aviation	70,828	52,157	-4.3%	45.8%	212
Worcester Regional	General Aviation	65,938	44,070	-5.6%	39.8%	63
Portsmouth International	General Aviation	32,586	38,132	2.3%	67.7%	117
Boston Logan International	Commercial Service	32,652	28,144	-2.1%	0.0%	-
Manchester-Boston	Commercial Service	27,538	12,504	-10.7%	21.8%	60
Total		657,145	522,070	-3.2%	39.8%	1,322
Sources: Massachusetts Port Authority; Federal Aviation Administration, ATADS; and FAA, Terminal Area Forecast, December 2012. Notes: ¹ Includes air taxi operations except for Manchester-Boston Airport, where air taxi operations counts are comingled with regional commuter airline operations. ² Hanscom Field based aircraft are from Massport records. All other based aircraft from FAA, Terminal Area Forecast. ³ Presents statistics for 2012.						

As shown in Table 1-4, GA operations at airports in the greater Boston area fell by 3.2 percent per year between 2005 and 2012, consistent with national trends. GA operations at all U.S. towered airports declined by 3.6 percent per year from 2005 to 2012.¹ High fuel prices, a weak economy, and a decline in the number of student pilots over the past decade have depressed the overall demand for GA. An even sharper drop in GA occurred following the economic recession of 2008-09 and a reduction in the use of corporate air transportation by many businesses. Over a two-year period from 2007 to 2009, GA operations in the U.S. fell by 15.5 percent.²

GA activity levels at Hanscom Field have remained relatively stable in recent years. Between 2007 and 2012, GA and military operations at Hanscom declined slightly by an average 0.1 percent per year. While Hanscom's current GA operations are still substantially lower than previous peak levels (over 204,000 in 2000 and over 300,000 in the 1970s), the airport has continued to accommodate a very strong level of GA demand and has performed well relative to other GA reliever airports in the region. With its proximity to Boston, as well as the growing metro-west suburbs and Route 128/I-495 area businesses, Hanscom is expected to continue to be the principal airport for the region's corporate and business aviation needs.

Ground Transportation

Consistent with conditions reported in the 2005 *ESPR*, Hanscom Field is not a significant contributor to traffic volumes on the roadways that surround the airport. Commercial and residential developments, coupled with reliance on single occupancy vehicles, remain the most significant source of traffic volume on area roadways. As Figure 1-4 indicates, Hanscom Field traffic comprises four percent of traffic on Route 2A during the morning peak hour and afternoon peak hours in 2012, comparable to 2005 levels. The contribution of Hanscom Field traffic to Route 2A volumes could increase to 5 percent in the 2020 planning scenario and 7 percent in the 2030 planning scenario.

¹ FAA, Aerospace Forecast, FY2013 – FY2033.

² Ibid.

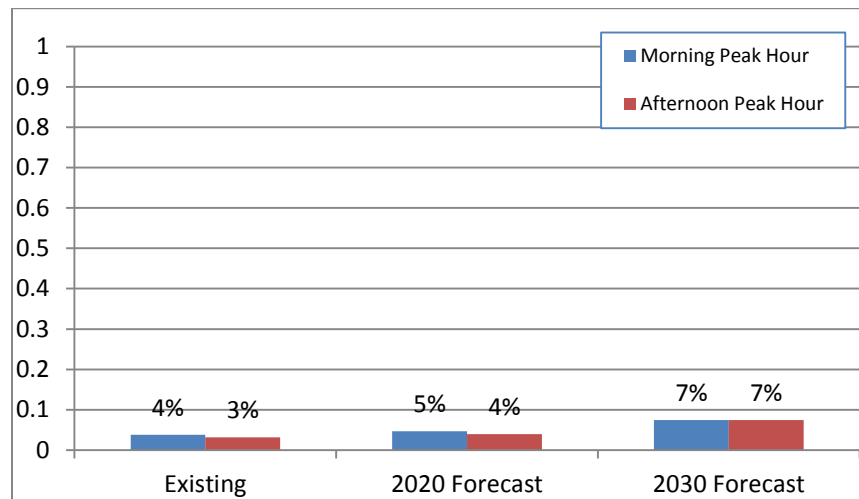


Figure 1-4 Hanscom Field Peak Hour Traffic Volumes as a Percent of Route 2A (East of Hanscom Drive) Traffic Volumes for Existing and Future Conditions

The lack of effect on area roadways by Hanscom Field is historical and long-standing. Traffic arrivals and departures by Hanscom Field employees and passengers are scheduled to avoid peak hour congestion. As Table 1-5 indicates, the amount of peak hour traffic generated in 2012 by Hanscom Field has not changed significantly since 2005. The average daily traffic volumes entering and exiting Hanscom Field have decreased from 2,600 in 2005 to 2,200 vehicles in 2012, consistent with the reduction in commercial air passenger and GA activity at the airport. Because of the refinements to the aviation activity forecasts, the 2020 and 2030 ground traffic volume estimates are significantly less than the 2005 *ESPR* estimates.

Table 1-5 Hanscom Field Peak Hour Trip Generation

Year/Scenario	Morning Peak Hour	Afternoon Peak Hour
2005 Actual	157	154
2012 Actual	165	121
2020 Forecast	220	166
2030 Forecast	384	336

The assessment of traffic operations at morning and afternoon peak for the 2020 and 2030 scenarios indicate that most intersections would operate at the same level of service or with slight increases in delay regardless of the level of Hanscom Field-related traffic growth. Transportation Demand Management (TDM) and operational approaches would be expected to minimize any slight increases in delay associated with the 2020 and 2030 scenarios.

Noise

In general, noise levels at Hanscom Field have decreased over the last several years, due primarily to decreases in operations, technological and development of quieter and better performing aircraft. In addition, Massport instituted changes in the Fly Friendly Program in 2009 to minimize flights over the MMNHP and nearby residential areas. Overall noise levels are projected to increase in the 2020 and 2030 planning scenarios, driven by forecast increases in Stage 3 GA jet activity.

Using radar data, Massport staff monitors the number of touch-and-go operations over the MMNHP. This data is a critical part of ongoing quarterly meetings between Massport, FAA air traffic control tower,

and flight school staff to review touch-and-go flight paths. Since the initiation of this program, flights over MMNHP have been reduced by an average of 21%.

Comparison of year 2012 Day-Night Sound Levels (DNL)³ noise contours to 2005 contours shows that overall noise levels decreased, largely due to lower activity levels by jets and Stage 2 GA aircraft, as well as decreased nighttime operations. The total population exposed to sound levels greater than DNL 65 dB has decreased from 17 people in 2005 to 0 people in 2012. The total population in the four towns exposed to DNL values of 55 dB or greater in 2012 is estimated to be 1,041, down from 2,953 in 2005. [DNL 65 dBA is a threshold at which the FAA defines a significant impact; DNL 55 dBA is the level for analysis requested by MEPA.] Table 1-6 presents the population estimates within the 65 and 55 DNL contours existing, past and future forecast scenarios. Even with the projected growth in operations for 2020 and 2030, no residents near Hanscom Field are expected to be located within the 65 dB contour and populations exposed to both the 65 dB and 55 dB contour will remain below 2005 actual levels. Figure 1-5 provides a visual comparison of the 2005 and 2012 DNL noise contours.

Table 1-6 Summary of U.S. Census Population Counts within DNL Contours

Year/Scenario	Population ¹	
	65 dB or Greater ²	55 dB or Greater ³
2000	26	2,848
2005	17	2,953
2012	0	1,041
2020	0	1,176
2030	0	1,859
Notes: 1. Based on the most recent U.S. Census information available 2. These population estimates fall within the 65 and 70 DNL contours. 3. These population estimates include population within the 55, 60, 65 and 70 DNL contours.		

The analysis of the 2020 and 2030 scenarios suggest that the greatest noise exposures would occur in the 2030 scenario since it has the highest projected activity levels. Even with activity increases over current levels, no noise analysis locations (including historic sites) would experience a DNL value greater than 60 dB under any future scenario. The Deacon John Wheeler/Capt. Jonas Minot Farmhouse and the Wheeler-Meriam House are the only historic sites that would experience noise levels between 55 and 60 dBA in the 2020 and 2030 scenarios.

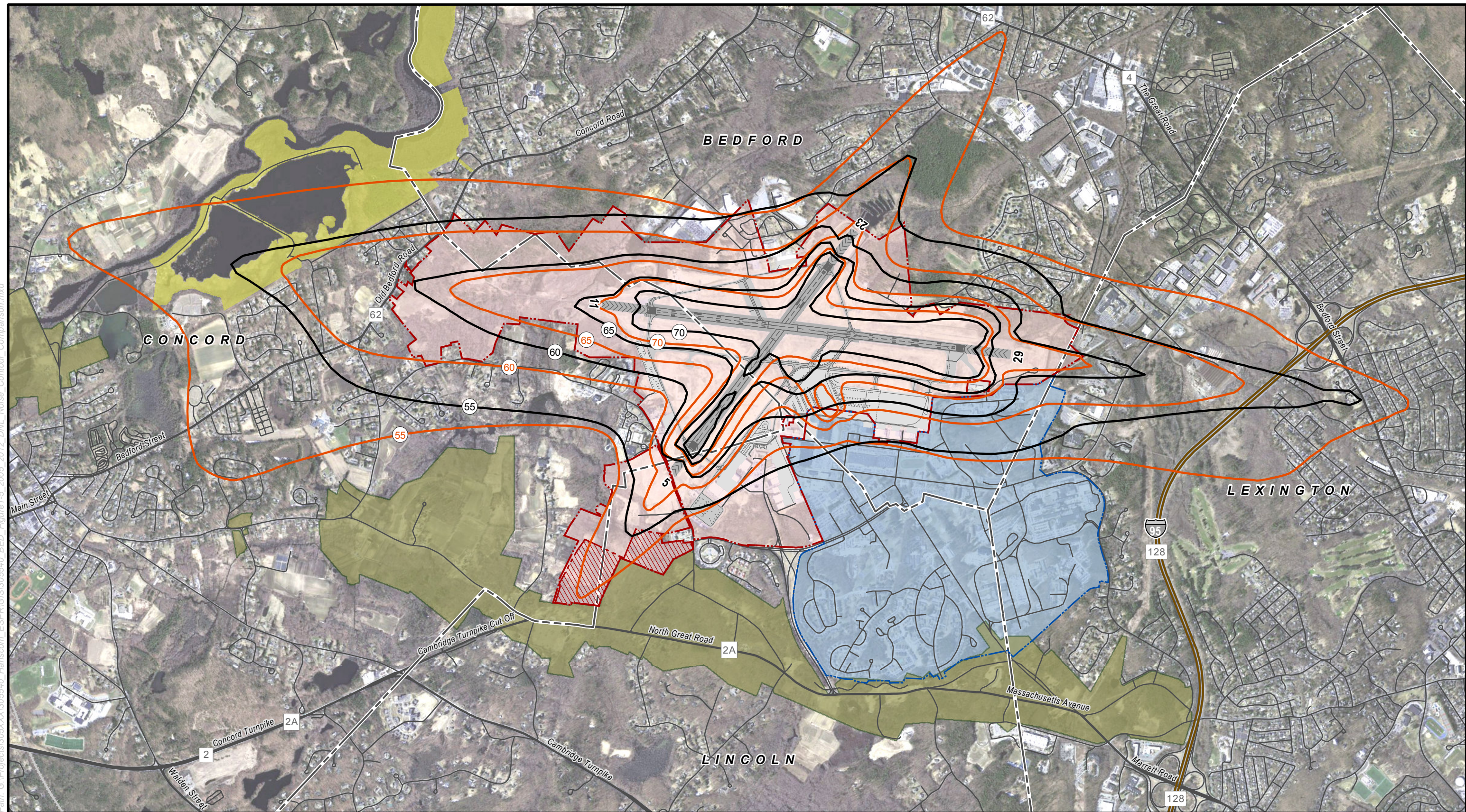
No portion of the MMNHP is located in the 55 DNL contour in 2012. For the 2020 scenario, the MMNHP will remain outside of the 55 DNL contour and only a small portion of the MMNHP (0.4 acres) will be in the 55 DNL contour in 2030.

Air Quality

Aircraft emissions for all pollutants decreased between 2005 and 2012. These changes are a result of the changes in the mix of aircraft operating at Hanscom Field as well as a reduction in the number of operations. Roadway emissions for all pollutants declined between 2005 and 2012 due to the effects of more stringent federal emission controls on motor vehicles. Table 1-7 presents changes in total air emissions at Hanscom Field between 1985 and 2012 and shows the overall improvements in air quality over the past two decades.

³ DNL: Average annual daily sound level, in decibels, computed on the basis of a 24-hour period.

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- 2012 DNL Noise Contour
- 2005 DNL Noise Contour
- Hanscom Field Property Boundary
- Massport Property within MMNHP Congressional Boundary
- Hanscom AFB Property Boundary
- Municipal Boundary

- Historic Road
- Interstate
- Highway
- Road
- Trail
- Active Rail Service

- Open Water
- Wetland/Marsh
- Stream
- MMNHP Boundary
- Great Meadows
- Open Space Non-protected
- Open Space Protected in Perpetuity



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

2005 and 2012 DNL Noise Contour Comparison

Data Sources: MassGIS (Roads, Rail), March 5, 2013; MassGIS (Community Boundaries), March 5, 2013; NPS (Park Boundary), March 8, 2013; ArcGIS - Bing Online (Bing ArcGIS Online, 2011), May 10, 2013

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Table 1-7 Total Air Emissions at Hanscom Field (1,000s of kg/yr)

Pollutant/Source	Year						Percent Change (Total)			
	1985	1995	2000	2005 (EDMS v4.3)	2005 (EDMS v5.1.4.1)	2012	1985 to 2005	1995 to 2005	2000 to 2005	2005 to 2012
CO										
Aircraft	698.8	409.2	591.2	483.6	1,670	1,123				
Ground Vehicles	49.2	30.3	60.8	36.1	36.1	19.05				
Total	748.0	439.5	652.0	519.7	1,706.1	1,142.1	-31%	+18%	-20%	-33.1%
NO_x										
Aircraft	14.2	14.9	25.4	28.0	34.1	31.9				
Ground Vehicles	5.1	3.9	6.9	4.1	4.1	2.18				
Total	19.3	18.8	32.3	32.1	38.2	34.1	+66%	+71%	-1%	-10.7%
VOC										
Aircraft	38.3	27.9	39.4	58.1	112.7	80.4				
Ground Vehicles	5.0	2.9	3.0	1.6	1.6	0.86				
Total	43.3	30.8	42.4	59.7	114.3	81.3	+38%	+94%	+41%	-28.9%
PM₁₀										
Aircraft	2.6	2.3	2.3	3.0	13.5	9.9				
Ground Vehicles	0.4	0.6	0.21	0.14	0.14	0.10				
Total	3.0	2.9	2.51	3.14	13.6	10.0	+5%	+8%	+25%	-26.5%
PM_{2.5}										
Aircraft	2.6	2.3	2.3	3.0	13.5	9.9				
Ground Vehicles	0.4	0.6	0.16	0.10	0.10	0.06				
Total	3.0	2.9	2.46	3.10	13.6	9.96	+3%	+7%	+26%	-27%
CO₂										
Aircraft	7,280.6	6,727.8	10,108.1	11,806.6	19,233	16,356				
Ground Vehicles	-	-	1,495.6	1,312.3	1,312.3	1,555.4				
Total	-	-	11,603.6	13,118.9	20,545	17,911	-	-	+13%	-12.8%
Note: 1. Data to calculate the ground vehicle CO ₂ emissions for 1985 and 1995 were not available; therefore, total CO ₂ emissions for these years are not available for comparison with later years 2. Percent total based on EDMS 5.1.4.1 to estimate aircraft emissions for 2005 and 2012.										

All current and predicted year 2020 and 2030 air pollutant concentrations are safely in compliance with state and federal health-based air quality standards. Calculations of annual emissions from aircraft operations and motor vehicles accessing the airport demonstrate that Hanscom Field emissions are a very small fraction of regional emissions.

Wetlands/Wildlife/Water Resources

In 2008, Massport updated its Vegetation Management Plan (VMP) to address the goals of aviation safety and natural resource management. In accordance with the VMP, Massport removed vegetative obstructions to Runway 23. This project also resulted in the renewal of trail connections between Bedford and Concord conservation lands. Additional wetland areas around the Terminal Area have also been delineated as part of proposed redevelopment projects including a new hangar proposed by Jet Aviation. An updated composite wetlands plan showing newly identified wetland areas is provided in this ESPR. Table 1-8 presents the current state-listed Endangered, Threatened, or Special Concern Species at Hanscom Field. Future development contemplated to support increased aircraft activity levels is not currently proposed in any areas currently identified as habitat for state-listed species. Most new development is also located outside of wetlands and buffer zones. Activities proposed in areas subject to review under the Massachusetts Wetlands Protection Act (MAWPA) are subject to review by the municipal conservation commission and Massport will make the necessary filings.

Table 1-8 Endangered, Threatened, or Special Concern Species at Hanscom Field

Common Name	Latin Name	Status ¹
Upland Sandpiper	<i>Bartramia longicauda</i>	Endangered
Grasshopper Sparrow	<i>Ammodramus savannarum</i>	Threatened
Blanding's Turtle	<i>Emydoidea blandingii</i>	Threatened
Wood Turtle	<i>Glyptemys insulpta</i>	Special Concern
Source: Natural Heritage and Endangered Species Program, January 13, 2013 letter		
Notes: 1. In accordance with the Massachusetts Endangered Species Act (M.G.L. Ch. 131A) and regulations (321 CMR 10.03)		

Massport has been working cooperatively with the Massachusetts Department of Environmental Protection (MassDEP), the U.S. Environmental Protection Agency (EPA), and the U.S. Air Force (USAF) to improve the flow characteristics and profile of stormwater discharges into the Shawsheen River. Massport continues to evaluate pavement removal to decrease impermeable areas on the airfield and has incorporated water quality and quantity improvements into ongoing projects using Low Impact Development (LID) technologies. Massport has also taken measures to control stormwater discharges into the river directly. In 2008, Massport had silt and sand removed from portions of three storm drainpipes just upstream from the Shawsheen River. In 2009, Massport completed soil permeability testing related to the potential installation of additional stormwater structures designed to increase groundwater recharge and decrease runoff.

Massport continues to comply with its Spill Prevention Control and Countermeasure (SPCC) Plan. The “State of Hanscom” states that there has been one reported spill at Hanscom Field since 2005. The spill was reported to MassDEP and appropriate measures were taken to protect the environment. During 2003 and 2004, Massport conducted a deicing study and monitoring at Hanscom Field. The study showed that neither current nor future scenario deicing at Hanscom Field would adversely affect the water supply for Bedford, Burlington or any other community. Massport continues to utilize the results of this study in evaluating impacts of deicing materials at Hanscom.

Any projects implemented under the 2020 and 2030 scenarios will meet requirements of the Stormwater Regulations under the MAWPA and its National Pollutant Discharge Elimination System (NPDES) permit.

Cultural and Historical Resources

The Massachusetts Historical Commission (MHC) maintains the State Register of Historic Places, MHC Inventory, and the Massachusetts Cultural Resource Information System (MACRIS). These resources provided baseline information for Bedford, Concord, Lexington, and Lincoln, which was supplemented through research of the MHC Inventory and the MACRIS files, discussions with the historic commissions for each of the four towns and research of their files, and discussions with the National Park Service (NPS). The inventory of existing cultural and historical resources included the identification of historic buildings and landscapes in MMNHP.

The 2012 *ESPR* describes the potential environmental effects of traffic, air quality, and noise on cultural and historical resources. Impacts from roadway improvements are unlikely given Hanscom’s comparatively small contribution to traffic and Massport’s preference for TDM and other traffic management strategies that do not require physical modification to intersections. There are no expected

adverse effects attributable to air quality in 2012 or under the 2020 and 2030 scenarios for any cultural and historic resources.

Table 1-9 lists noise exposure for 2005 and 2012 to demonstrate recent trends and for the forecasted 2020 and 2030 scenarios for State Register properties, the MMNHP, Great Meadows National Wildlife Refuge (GMNWR), and key conservation and recreational facilities. The results show that noise exposure has decreased significantly from 2005 to 2012 for all of the cultural and recreational areas listed. For future scenarios, noise exposure levels at State Register historic properties would increase from DNL 0.5 to 1.5 dBA above 2012 levels in the 2020 planning scenario to DNL 1.5 to 2.0 dBA above 2012 levels in the 2030 scenario. Figure 1-6 illustrates the location of historic resources relative to the recent noise levels (2005 and 2012) and projected noise levels (2020 and 2030 scenarios).

Analysis shows that no buildings or historic districts have exposure above 65 dB DNL in 2012 or would have exposure above DNL 65 dBA in any of the 2020 or 2030 scenarios. For the Hartwell Town Forest/Jordan Conservation Area, approximately 0.1 acres would be exposed to the DNL 65 dBA contour in 2012, a decrease from 1.4 acres in 2005. No historic districts including the MMNHP exist within the DNL 55 dBA contour in 2012. Two individual National and State Registers properties have DNL values greater than DNL 55 dBA in 2012, which are 1.7 to 2.0 dB lower than in 2005, respectively:

- The Deacon John Wheeler/Capt. Jonas Minot Farmhouse (aka Thoreau Birthplace), 341 Virginia Road in Concord at DNL 58.4 dBA
- The Wheeler-Meriam House, 477 Virginia Road in Concord at DNL 58.1 dBA

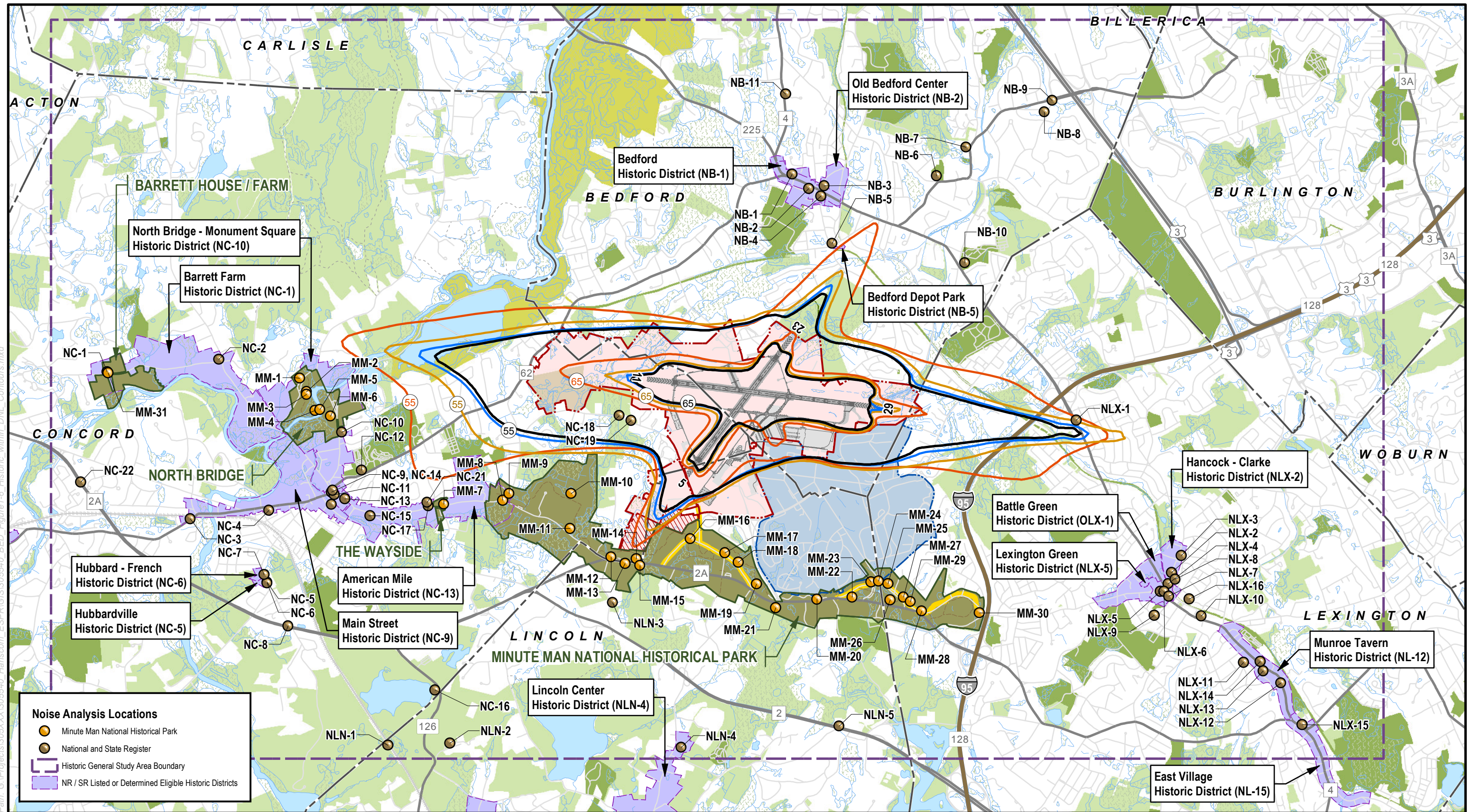
Additionally, the Simonds Tavern (331 Bedford Street, Lexington), which was included in this group in 2005, has a value lower than DNL 55 dBA (53) in 2012.

Areas within the 55 DNL contour in the MMNHP have decreased since 2005 but are projected to increase marginally under the year 2030 scenario. In 2012, no area of the MMNHP is within the 55 DNL contour dropping from 1.7 acres in 2005. Assuming increases in aircraft activity levels for the planning scenarios, the 55 DNL contour area within MMNHP is expected to remain at 0 acres in 2020 and increase to 0.4 acres in 2030.

Massport encourages new development in areas with existing impervious surfaces that take advantage of existing infrastructure. Any physical changes proposed near archaeological sites located in undisturbed portions of the airport have the potential to affect archaeological resources. Using the detailed archaeological reconnaissance survey conducted within the Hanscom Field property boundaries for the 2005 *ESPR*, which was reassessed in 2012, potential effects of future development on archaeological resources can be evaluated.

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Path: G:\Projects\305XXX\305540_Hanscom_ESPR\GIS\305540_BED_Figure1-6_Historic_within_DNL_Contours.mxd



North

0 3,500 7,000 Feet

2005 DNL Noise Contour

2012 DNL Noise Contour

2020 DNL Noise Contour

2030 DNL Noise Contour

Hanscom Field Property Boundary

Massport Property within MMNHP Congressional Boundary

Hanscom AFB Property Boundary

Municipal Boundary

Historic Road

Interstate

Highway

Road

Trail

Active Rail Service

Open Water

Wetland/Marsh

MMNHP Boundary

Great Meadows

Open Space Non-protected

Open Space Protected in Perpetuity

Stream

Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Historic Resources within the 2005, 2012, 2020 and 2030 DNL Noise Contours

Data Sources: ESRI (USGS Topographic Maps), March 4, 2013; MassGIS (Community Boundaries), March 5, 2013; PAL, Inc. (Noise Sensitive Receptors), August 28, 2013

Figure 1-6

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Table 1-9 Summary of Noise Effects on Cultural and Historic Resources

Resource ¹	Total Quantity ²	Total Properties or Geographic Area within the 65 DNL Contour ³			
		2005	2012	2020	2030
National and State Register Individual Properties ⁴	39 properties	0 properties	0 properties	0 properties	0 properties
National and State Register Historic Districts ⁵	1,646.2 acres	0 acres	0 acres	0 acres	0 acres
Minute Man National Historical Park	975.4 acres	0 acres	0 acres	0 acres	0 acres
Battle Road Interpretive Trail	4.0 miles	0 miles	0 miles	0 miles	0 miles
Minuteman Commuter Bikeway	10.1 miles	0 miles	0 miles	0 miles	0 miles
Narrow Gauge Rail-Trail	3.0 miles	0 miles	0 miles	0 miles	0 miles
Hartwell Town Forest/ Jordan Conservation Area	165.9 acres	1.4 acres	0.1 acres	0.1 acres	0.9 acres
Great Meadows National Wildlife Refuge	3,409 acres	0 acres	0 acres	0 acres	0 acres
Concord River ⁶	6.5 miles	0 miles	0 miles	0 miles	0 miles
Resource ¹	Total Quantity ²	Total Properties or Geographic Area within the 55 DNL Contour			
		2005	2012	2020	2030
National and State Register Individual Properties ⁴	39 properties	3 properties	3 properties	3 properties	3 properties
National and State Register Historic Districts ⁵	1,646.2 acres	2.4 acres	0 acres	0 acres	0 acres
Minute Man National Historical Park	975.4 acres	1.7 acres	0 acres	0 acres	0.4 acres
Battle Road Interpretive Trail	4.0 miles	0 miles	0 miles	0 miles	0 miles
Minuteman Commuter Bikeway	10.1 miles	1.3 miles	0.3 miles	0.4 miles	0.5 miles
Narrow Gauge Rail-Trail	3.0 miles	1.3 miles	0 miles	0 miles	0 miles
Hartwell Town Forest/ Jordan Conservation Area	165.9 acres	118 acres	26.4 acres	66.4 acres	72.1 acres
Great Meadows National Wildlife Refuge	3,409 acres	210 acres	26.4 acres	43.1 acres	94.4 acres
Concord River ⁶	6.5 miles	0.5 miles	0 miles	0 miles	0.1 miles
Notes: 1. See Tables 10-19 and 10-20 for more detail on National and State Register individual properties and historic districts. 2. All surveyed historic properties; total acreage of surveyed historic districts, Minute Man National Historical Park, Hartwell Town Forest/Jordan Conservation Area, and Great Meadows National Wildlife Refuge; and, total length of trails and Concord River. 3. This is the exposure level that the FAA identifies as a guideline for determining potential land use incompatibilities. 4. Does not include Minute Man National Historical Park sites. In this table, the noise effects are quantified through the estimation of park acreage within a given contour. 5. Includes Bedford Depot Park Historic Dist., Bedford Historic Dist., and Old Bedford Center Historic Dist. in Bedford; American Mile Historic Dist., Barrett Farm Historic Dist., Concord Monument Square-Lexington Road Historic Dist., Hubbard-French Historic Dist., Hubbardville Historic Dist., Main Street Historic Dist., and North Bridge-Monument Square Historic Dist. in Concord; Battle Green Historic Dist., East Village Historic Dist., Hancock-Clarke Historic Dist., Lexington Green Historic Dist. and Munroe Tavern Historic Dist. in Lexington; and, Lincoln Historic Dist. in Lincoln. Areas of overlap in districts are counted once. 6. Concord River is approximately 6.5 miles in length from State Route 2 (South of Airport) to State Route 225 (North of Airport)					

Development at Hanscom contemplated to support 2020 and 2030 activity levels is considered for four planning areas: Terminal Area, Air Traffic Control Tower (ATCT) Apron, East Ramp, and North Airfield. Any proposals considered for the ATCT Apron and East Ramp would be directed to existing impervious areas which have low sensitivity for archaeological resources. Some areas evaluated for future development on the North Airfield are pervious, but previously disturbed, and therefore have low

archaeological sensitivity. Development considered in the Terminal Area includes both pervious and impervious areas adjacent to existing facilities. The areas that are presently vegetated have been identified as having a high sensitivity for archaeological resources. Any proposed future activities under the 2020 and 2030 scenarios that involve ground disturbance in areas of archaeological sensitivity or near known archaeological sites will require more detailed investigation as part of the individual permitting of the project. No physical modifications are proposed to improve traffic intersections, and therefore there are no adverse effects to these resources in 2012 or under the 2020 and 2030 scenarios.

Sustainable Development / Environmental Management System (EMS)

Massport is a leader among Massachusetts agencies and airport operators nationally in the promotion and implementation of sustainable design and operations. This is reflected in two relevant examples: (1) Boston Logan Terminal A was the first terminal in the world to achieve Leadership in Energy and Environmental Design (LEED) certification⁴; and (2) Hanscom was the first US airport to achieve ISO 14001 certification. Logan's new Rental Car Center and the recently completed Green Bus Depot are also anticipated to achieve LEED Silver certification. Since the 2005 *ESPR*, Massport has established a number of policies and implemented projects to advance sustainability at all of its facilities including Hanscom.

Massport requires that new development, including that conducted at Hanscom, meet performance standards established by the LEED program for Silver certification. LEED certification is achieved through the incorporation of sustainability commitments in building design and operation including energy efficiency, use of environmentally-friendly products, reuse and recycling, and renewable energy. At Hanscom, as an example, the new Liberty Mutual Hangar includes a range of environmentally-friendly elements to reduce energy utilization and environmental management. Rectrix Aviation is constructing a new state-of-the-art FBO facility which is designed to achieve LEED Silver certification to replace Hangar 24. In addition to LEED, Massport has developed Sustainable Design Standards and Guidelines which are used to plan, design, and construct all new development projects on Massport properties. Massport has constructed solar photovoltaic (PV) panels on the Hanscom Terminal Building to provide onsite renewable energy and reduce its demand for power from offsite electricity sources. It has also used warm-mix asphalt, a lower energy intensity pavement, in several areas at Hanscom. Massport will continue to encourage future development of Hanscom Field facilities to be performed in a sustainable manner.

Environmentally Beneficial Measures

Environmentally beneficial measures are those actions identified in each of the technical chapters of the *ESPR* that could be implemented to minimize potential effects of existing activities at Hanscom. Massport recognizes the importance of operating and developing Hanscom Field in a manner that maximizes its contribution to the regional transportation system while minimizing potential impacts on local communities and stakeholders. A number of actions have been implemented since the 2005 *ESPR* and others are proposed in the future to achieve that goal.

⁴ The U.S. Green Building Council developed the LEED Green Building Rating System[®] to rate the sustainability of different building types.

In accordance with the EEA Scope for the 2005 *ESPR*, Table 1-10 presents the responsible parties, implementation and schedule of beneficial measures that are presented in the 2012 *ESPR*.

Table 1-10 Summary of Existing and Possible Future Environmentally Beneficial Measures

Measure	Responsible Party	Timetable
GROUND TRANSPORTATION		
Transportation information on Massport website	Massport	Ongoing
Transit information in Civil Air Terminal	Massport	Ongoing
Participation as a partner in MassRIDES Transportation Management Initiative program	Massport	Ongoing
Information about transit and non-auto travel options in prominent locations throughout Hanscom Field	Massport	2014
Bus shelter with transit information	Massport	2014
Exploration of working with local communities and stakeholders on a bikeshare network	Multiple parties including Massport	Ongoing
NOISE		
Modifications to the Fly Friendly Program using the flight tracking software to direct pilots conducting touch-and-go procedures to fly more over the airport than neighboring lands	Massport	Ongoing
Continued implementation of the Fly Friendly program	Massport	Ongoing
Run-up procedures for use of the East Ramp	Massport	Ongoing
Relocation of noise monitors based on input from ongoing community coordination process and implementation of updates to the Noise and Operations Monitoring System	Massport	2014
Creation of the "Airport Activity Monitor" which allows the public to research a noise event or flight, log a noise disturbance, and track correspondence related to a noise disturbance.	Massport	Ongoing
AIR QUALITY		
Continued encouragement of tenants to consider the purchase of alternatively fueled ground service equipment, where appropriate	Massport	Ongoing
Encouragement of Fixed Base Operators to minimize Auxiliary Power Unit/Ground Power Unit use	Massport	Ongoing
Use of Ultra Low Sulfur Fuel in Massport fleet vehicles	Massport	Ongoing
Evaluation of the installation of a paved aircraft holding area at the head of Runway 23 to reduce minor aircraft delays	Massport	2014-2016
Continued consideration of Alternative Fuel Vehicles for any new Massport vehicle purchase	Massport	Ongoing
WATER QUALITY		
Support for Shawsheen Watershed Initiative to improve water quality and quantity flow in the Shawsheen River and its tributaries	Massport working with the MassDEP, USEPA, and Hanscom AFB	Ongoing
Stormwater improvements to construct detention areas around Hanscom in conjunction with the USAF	Massport through MassDEP grant	2014-2016
Continuation of MassDEP Best Management Practices	Massport	Ongoing
WILDLIFE		
Manage airfield in a manner that does not disrupt breeding season for grassland birds of which two species are listed under the Massachusetts Endangered Species Act	Massport	Ongoing
SUSTAINABLE DEVELOPMENT		
Implementation and maintenance of EMS procedures to control environmental effects	Massport	Ongoing

While site-specific noise abatement is not proposed, the advancement of Massport's noise abatement program is described. It is important to note that no noise-analysis locations experienced a DNL value greater than 60 dB in 2012 (i.e., DNL 5 dBA quieter than FAA's threshold of significance) nor would any site be expected to experience a DNL value greater than 60 dB under the 2020 and 2030 scenarios.

1.6 MEPA Documentation

Massport typically submits the ESPR on a five-year cycle. As described above, with the EEA Secretary's consent, preparation of this ESPR was deferred given the local and national decreases in aviation activity and the corresponding declines at Hanscom.

The *2012 ESPR* is posted on Massport's web site (www.massport.com) and is available in CD-ROM to all commenters. Hard copies of the report are available upon request. All four town libraries, Planning Departments, and Conservation Commissions have received both a CD-ROM and hard copy of the *2012 ESPR*.

In addition to the ESPR process, Massport publishes two annual reports for public review: the "State of Hanscom" and the "Annual Noise Report." Both documents are distributed to the Hanscom Field Advisory Commission (HFAC) and are available on Massport's website. The "State of Hanscom" describes Massport's financial performance, economic benefits and accomplishments, as well as its plans for the near future. The report also includes information on aircraft activity from the past year. Massport will continue to use this process to distribute information about Hanscom Field. The first noise report for Hanscom Field was prepared in 1982, and it compared data for 1978 and 1981. Annual updates were started in 1984 (based on the previous year's data), making 2012 the 31th Hanscom noise report.

1.7 Organization of the 2012 ESPR

The *2012 ESPR* contains planning information, technical analyses, and supportive data, including the Secretary's May 18, 2012 Certificate, comment letters on the Draft Scope for the *2012 ESPR*, responses to the Certificate and the comment letters, a list of reviewers and technical appendices. The Introduction / Executive Summary provides a brief overview of the content and key findings of each chapter. The technical appendices provide detailed analytical data and methodological documentation for the various environmental analyses conducted for this *2012 ESPR*.

Chapter 1: Introduction / Executive Summary

- Provides background of Hanscom Field
- Discusses the environmental and regulatory context
- Identifies the analytical framework for the ESPR
- Summarizes the primary changes since 2005
- Presents an overview of the outreach program and public engagement process
- Provides the organization for the report

Chapter 2: Airport Facilities and Infrastructure

- Describes the airfield and its supporting infrastructure, including parking and the utility system serving the airport
- Describes Massport's tenant audit program
- Provides information about the tank management program and spill prevention efforts at Hanscom Field

Chapter 3: Airport Activity Levels

- Presents an analysis of different descriptors to characterize future scenarios
- Describes the aircraft operations, including nighttime operations, and passenger activity levels for 2012 and compares the 2012 data to historic trends and forecasts from the *2005 ESPR*
- Describes the forecast coordination with the Logan ESPR and the FAA's NERASP study

- Presents 2020 and 2030 aircraft operation and air passenger forecasts for the future planning scenarios
- Describes the procedures for new airline entrants at Hanscom Field

Chapter 4: Airport Planning

- Describes the status of planning initiatives and projects for the terminal area, airside area and landside area
- Evaluates the potential effects of the 2020 and 2030 scenarios on the airport infrastructure
- Presents the relationship between the 2012 *ESPR* and Executive Orders 385 and 438
- Describes projects in the five-year capital program and identifies which projects may require individual MEPA review
- Describes new Transportation Security Administration or Massport security policies
- Updates any new planning and development initiatives at the MMNHP, Hanscom AFB, and the four contiguous towns
- Addresses the consistency of planning strategies with the following:
 - Local comprehensive plans
 - Four Town Planning Study
 - MAPC's regional policy plan
 - Hanscom Area Towns (HATS) Master Plan

Chapter 5: Regional Transportation Context

- Provides a summary of the regional transportation system
- Describes the role of Hanscom Field in the region's transportation system
- Describes activities at other regional airports
- Describes the long-term advantages and disadvantages of Hanscom Field as a commercial reliever airport
- Discusses Hanscom Field's role as a GA reliever airport

Chapter 6: Ground Transportation

- Reports on current conditions and potential conditions in the 2020 and 2030 analysis years for traffic, roadway and access, including intersection operations and Average Daily Traffic volumes
- Provides mode share data including tenant survey results
- Describes the review process with local towns; presents information on Transportation Demand Management
- Reviews, summarizes and analyzes existing metropolitan planning documents
- Discusses the status of existing and future parking needs at Hanscom Field

Chapter 7: Noise

- Updates the status of the noise environment around Hanscom Field for 2012 conditions and for the 2020 and 2030 analysis years, including the following:
 - Total Noise Exposure (EXP) calculations
 - DNL, Time-Above (TA) and Single Event contours
 - Single Event Level (SEL) Distribution metrics
 - Ranked tabulation of take-off noise levels
- Reports past trends and the projections for the forecast activity levels and years and adjustments for such changes in the Integrated Noise Model (INM)

- Addresses the issue of engine run-ups and the operation of Auxiliary Power Units and Ground Power Units
- Addresses potential measures to reduce noise impacts from airport operations

Chapter 8: Air Quality

- Reports on 2012 conditions and conditions in the 2020 and 2030 analysis years including the following:
 - Carbon monoxide
 - Oxides of nitrogen
 - Volatile organic compounds
 - Particulate matter
 - Monitoring results for ozone precursors and nitrogen dioxide
 - Summary of national lead emission standards
- Presents a review of environmentally beneficial measures including the following:
 - Airside operational improvements
 - Ground service and landside conversion to alternative fuels
 - Aviation support emissions reductions
- Discusses the clean vehicle program at Hanscom Field

Chapter 9: Wetlands/Wildlife/Water Resources

- Describes the natural environment at Hanscom Field including the following:
 - Wetlands delineations
 - Vernal pools
 - Wildlife habitats
- Reports on the surface stormwater management system
- Provides an update on the Vegetation Management Plan (VMP)
- Presents information about Massport's National Pollution Discharge Elimination System (NPDES) permit
- Provides figures that illustrate the current wetlands resources at Hanscom Field and the location of local water supplies
- Identifies current and proposed use of de-icing chemicals

Chapter 10: Cultural and Historical Resources

- Reviews the existing data on historical and archeological resources located at and near Hanscom Field
- Presents information about the MMNHP and historical properties in the park
- Evaluates the potential effects future planning scenarios for the 2020 and 2030 analysis years

Chapter 11: Sustainable Development and Environmental Management System (EMS)

- Discusses reduction in the use of toxic materials at Hanscom Field
- Reports on Massport's sustainable design program at Hanscom Field
- Provides information on the sustainable design approaches for new and existing facilities
- Provides information on the EMS Program

Chapter 12: Environmentally Beneficial Measures

- Summarizes environmentally beneficial measures that are identified in previous chapters
- Identifies, in general terms, parties responsible, costs and schedule for implementation

Appendices:

- A Glossary of Terms that defines key terms used in the *2012 ESRP* and an Abbreviations and Acronyms directory
- List of Reviewers
- Appendix A that provides the Secretary's Certificate on the *2012 ESRP* Scope and a Response to Comments section
- Appendix B that provides the 2011 Airport Layout Plan
- Appendix C through Appendix G are technical appendices that provide detailed analytical data and methodological documentation for the various environmental analyses conducted for the *2012 ESRP*.

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2 Airport Facilities and Infrastructure

Hanscom Field is a Federal Aviation Administration (FAA) certified airport (per 14 CFR Part 139). It is one of three airports owned and operated by the Massachusetts Port Authority (Massport). Located about 20 miles northwest of Boston, Hanscom Field plays an important role as a corporate and General Aviation (GA) reliever to Boston Logan International Airport. Massport operates Hanscom as a class 1 airport facility which serves all types of scheduled operations of air carrier aircraft designed for at least 31 passenger seats), whose major users are a mix of corporate aviation, private pilots, flight schools, commuter/commercial air services, as well as some charter and light cargo.

This chapter provides updated information about Hanscom's airport facilities and infrastructure since the publication of the previous Environmental Status and Planning Report (ESPR) in 2006. The description of airside and landside facilities includes runways, taxiways, aprons, hangars, general aviation facilities, roadways, parking, and utility systems. The chapter also discusses the status of programs designed to prevent, reduce, and mitigate the occurrence of environmental impacts related to the use and storage and handling of fuel.

2.1 Key Findings Since 2005

Efforts undertaken toward improving and updating airport facilities and infrastructure at Hanscom since the 2005 *ESPR* are represented by the following projects:

- Runway Safety Area (RSA) improvements at Runway Ends 5 and 23 including grading of the RSA and wetland replication to meet federally-mandated airfield safety standards (2008)
- RSA improvements on Runway End 11 by relocating portions of the perimeter road (2012)
- Reconstruction of the western end of Taxiway E, Taxiway G, and Taxiway M (2009)
- Redevelopment of the Hangar 24 site for a Fixed Base Operator (FBO) facility by Rectrix Aviation, a project which is nearing completion at this time
- Removal of fuel storage tanks at Hangar 10 (2011)
- Implementation of enhanced access control system and replacement of a portion of the perimeter fence (2012)
- Relocation of portions of the perimeter road at approach to Runway 29 (2012)
- Ongoing airfield maintenance
- Ongoing vegetation removal and maintenance

Improvements in airport facilities and infrastructure since 2005 have not increased impervious surfaces. Additionally, there have been no significant changes in the utility systems or in the parking spaces since the 2005 *ESPR* inventory. While parking spaces located on property formerly leased by Massport to the United States Air Force (USAF) are now available to Hanscom, the inclusion of these parking spaces does not represent an increase as they were located on Hanscom Property prior to 2005.

2.2 Airport Facilities

Hanscom Field has two intersecting asphalt-paved runways and additional supporting infrastructure. Runway 11-29 is oriented in an east/west configuration and Runway 5-23 is oriented in a northeast/southwest configuration. Supporting infrastructure includes taxiways, a FAA-owned and operated air traffic control tower (ATCT), navigational aids (NAVAIDs), aircraft aprons, hangars, passenger terminal buildings, US Customs and Border Protection (CBP), and other aviation support facilities. These facilities are described in more detail below.

2.2.1 Runways

Two intersecting runways at Hanscom provide aircraft with four approach options. Runway 11-29 is the primary runway. The runway thresholds and runway ends are located at the extremity of the pavement, which is 150 feet wide, and allows 7,011 feet for landings and departures in both directions. This runway is a precision instrument runway because each end of the runway is equipped with an Instrument Landing System (ILS) with Distance Measuring Equipment (DME). The runway is equipped with a Medium Intensity Approach Lighting System and Runway Alignment Indicator Lights (MALSR) and High Intensity Runway Lighting System (HIRLS). Both runway ends have paved runway safety areas beyond the runway end that are 200 feet wide and 1,000 feet long. Both runway ends are equipped with a four-light Precision Approach Path Indicator (PAPI).

Runway 5-23 is the secondary, crosswind runway. The runway thresholds and runway ends are located at the extremity of the pavement, which is 150 feet wide, allowing 5,107 feet for landings and departures in both directions. This runway is a non-precision instrument runway. The runway is equipped with a Medium Intensity Runway Lighting (MIRL) system and runway end identifier lights.

Beyond both runway ends are graded RSAs. At the approach end of Runway 23, the paved safety area is 200 feet wide and 890 feet long. At the approach end of Runway 5, the paved safety area is 200 feet wide and 682 feet long at the centerline. Both runway ends are equipped with a Visual Approach Slope Indicator (VASI).

2.2.2 Taxiways

A system of taxiways provides access between the two runways and aircraft parking aprons. Taxiway widths at Hanscom Field range from 50 to 75 feet. According to FAA criteria, a taxiway width of 50 feet can accommodate aircraft with a wingspan no greater than 118 feet and a wheelbase no greater than 60 feet. Similarly, a 75-foot wide taxiway can accommodate aircraft with a wingspan no greater than 214 feet (Group V). The extremities of all four runway ends are connected by taxiways that allow aircraft to utilize the full available runway length without the need to backtrack. On the south side of the runway, the full-length parallel Taxiway E supports Runway 11-29. In addition, Taxiways F and G provide mid-point access to the runway. Taxiway G crosses Runway 11-29 and provides direct access to the extremity of Runway 23. Taxiway R provides connection on the north side of the airfield between the extremities of Runway 23 and Runway 11, while Taxiway N provides mid-point access to Runway 11-29. Finally, Taxiway S is a partial parallel to Runway 5-23.

In addition to the taxiways that provide direct access to the runways, Hanscom has a series of taxiways that provides connectivity between these taxiways and the aircraft parking aprons. Taxiways A, B, and C provide connection to the East Ramp that is in front of the USAF and Civilian hangars, and the CBP building.

2.2.3 Air Traffic Control Facilities and Navigational Aids

The FAA, who manages Hanscom's airspace, provides air traffic control at Hanscom Field.⁵ FAA rules and regulations govern the movement of air traffic at Hanscom. The FAA's Consolidated Terminal Radar Approach Control (TRACON), located at Merrimack New Hampshire, has authority and responsibility for Instrument Flight Rule (IFR) arrivals, departures, and low-altitude (above 2,500 feet) over-flights in the controlled airspace surrounding Hanscom. By means of remote communication air/ground facilities, direct communication is maintained between TRACON controllers and individual pilots. The communication system is further augmented by radar coverage that enables TRACON controllers to monitor the location and movement of each aircraft.

The ATCT is located on the south side of the airfield by Taxiway J. The FAA owns the ATCT, operating it daily between 7:00 a.m. and 11:00 p.m. The tower staff directs the operations of aircraft within a five-mile radius of the airport. Air traffic controllers are responsible for controlling Hanscom's airspace. Close coordination is maintained between the ATCT and the FAA's Consolidated TRACON.

FAA-owned and maintained, electronic NAVAIDs serving Hanscom are located on and near the airport and are used to support instrument approach procedures. Runways 11 and 29 are both equipped with a Category I ILS. The ILS provides pilots with electronic guidance for aircraft alignment (horizontal), descent gradient (vertical), and aircraft position until visual contact is made with the runway. Runway 11 is also supported with a runway visual range (RVR) system consisting of a projector and receiver. The RVR provides a measurement of horizontal visibility. A Very-High-Frequency Omni-Directional Range (VOR) station, located near Lawrence Massachusetts, provides a non-precision instrument approach to Runways 5 and 23 at Hanscom Field.⁶

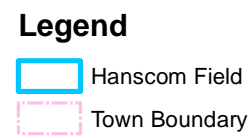
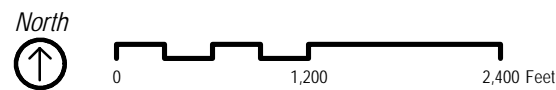
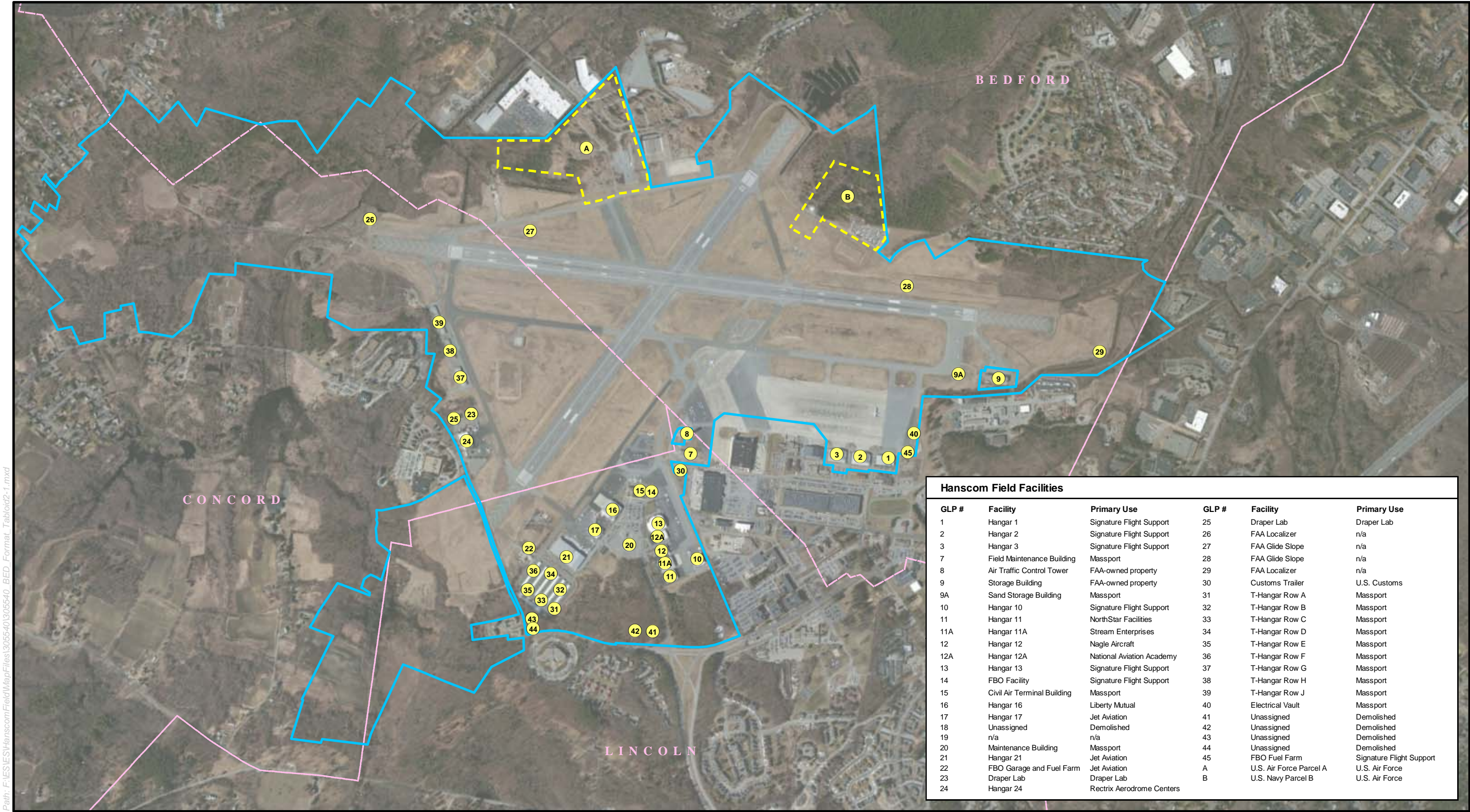
2.2.4 Buildings and Hangars

The primary existing facilities at Hanscom are considered to be in good condition. Some of the older buildings lack amenities. Table 2-1 provides a summary of existing building size and condition (i.e., excellent, good, fair, or poor). Figure 2-1 serves as a reference guide to the facilities listed in Table 2-1 and illustrates the location of leased properties. One parcel of land in the North Airfield Area, consisting of area above and below Hartwell Road, was returned to Massport control in 2011. The available vehicle parking for these facilities is presented in this chapter in Table 2-2.

⁵ Massport and Federal Aviation Administration (FAA), *Runway 5-23 Safety Area Improvements Draft Environmental Assessment and Draft Environmental Impact Report*, July 2006.

⁶ Airport IQ 5010: Airport Master Records and Reports. <http://www.gcr1.com/5010web/airport.cfm?Site=BED>.

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Table 2-1 Hanscom Field Buildings & Hangar Facilities

2005 GLP No. ¹	Facility ²	Primary User ²	Total S.F. Building Footprint ²	Year Built ²	Condition ^{2,3}	Facility Type/ Comments
1	Hangar 1	Signature Flight Support	28,376	1955	Fair	Fixed Base Operator
2	Hangar 2	Signature Flight Support	36,000	1955	Fair	Fixed Base Operator
3	Hangar 3	Signature Flight Support	36,000	1955	Fair	Fixed Base Operator
7	Field Maintenance Building	Massport	11,300	1984	Good	Airfield Maintenance
8	Air Traffic Control Tower	FAA-owned property	n/a	2002	Excellent	FAA Control Tower
9	Storage Building	FAA-owned property	n/a	n/a	n/a	Storage
9A	Sand Storage Building	Massport	2,500	2005	Excellent	Airfield Sand Storage
10	Hangar 10	Signature Flight Support	20,300	1950s	Good	Fixed Base Operator
11	Hangar 11	NorthStar Facilities	15,608	1969	Good	Corporate/Conventional GA Hangar
11A	Hangar 11A	Stream Enterprises	26,250	2001	Excellent	Corporate/Conventional GA Hangar
12	Hangar 12	Nagle Aircraft	14,300	2002	Excellent	Aircraft Maintenance Facility
12A	Hangar 12A	National Aviation Academy	23,763	1963	Good	Technical School (aircraft mechanics)
13	Hangar 13	Signature Flight Support	38,000	2001	Excellent	Fixed Base Operator
14	FBO Facility	Signature Flight Support	5,000	1988	Excellent	Fixed Base Operator
15	Civil Air Terminal Building	Massport	13,475	1953	Good	Passenger Terminal and Aviation Support
16	Hangar 16	Liberty Mutual	37,800	June 2005	Excellent	Corporate/Conventional GA Hangar
17	Hangar 17	Jet Aviation	21,315	1954	Poor	Fixed Base Operator
18	Classroom	National Aviation Academy	5,850	1983	Demolished in 2012	
19	n/a	n/a	n/a	n/a	n/a	Unused Building ID
20	Maintenance Building	Massport	2,500	1954	Fair	Building Maintenance
21	Hangar 21	Jet Aviation	40,000 34,000	1985 2000	Excellent	Fixed Base Operator
22	FBO Garage and Fuel Farm	Jet Aviation	4,500	1985	Excellent	Fixed Base Operator
23	Draper Lab	Draper Lab	n/a	n/a	n/a	Leased from Massport by the USAF
24	Hangar 24	Rectrix Aerodrome Centers	89,714	2013 - (under development)	Ongoing construction	New building and tenant on parcel scheduled for completion in 2013.

2005 GLP No. ¹	Facility ²	Primary User ²	Total S.F. Building Footprint ²	Year Built ²	Condition ^{2,3}	Facility Type/ Comments
25	Draper Lab	Draper Lab	27,000	1948	n/a	Leased from Massport by the USAF
26	FAA Localizer	n/a	n/a	n/a	n/a	
27	FAA Glide Slope	n/a	n/a	n/a	n/a	
28	FAA Glide Slope	n/a	n/a	n/a	n/a	
29	FAA Localizer	n/a	n/a	n/a	n/a	
30	Customs Trailer	U.S. Customs	4,000	n/a	n/a	
31	T-Hangar Row A	Massport	15,360	1972	Fair	New roof in 2005
32	T-Hangar Row B	Massport	16,128	1973	Fair	New roof in 2005
33	T-Hangar Row C	Massport	16,128	1973	Fair	New roof in 2005
34	T-Hangar Row D	Massport	16,051	1982	Fair	Installed roof coating in 2005
35	T-Hangar Row E	Massport	16,051	1982	Fair	Installed roof coating in 2005
36	T-Hangar Row F	Massport	16,051	1982	Fair	Installed roof coating in 2005
37	T-Hangar Row G	Massport	18,236	1987	Fair	Installed roof coating in 2011
38	T-Hangar Row H	Massport	15,744	1987	Fair	Installed roof coating in 2011
39	T-Hangar Row J	Massport	23,616	1987	Fair	Installed roof coating in 2011
40	Electrical Vault	Massport	4,000	n/a	Fair	
41	Residence	Massport	n/a	n/a	n/a	Demolished in 2010
42	Residence	Massport	n/a	n/a	n/a	Demolished in 2010
43	Residence	Massport	n/a	n/a	n/a	Demolished in 2010
44	Residence	Massport	n/a	n/a	n/a	Demolished in 2010
45	FBO Fuel Farm	Signature Flight Support	3,996	1976	Good	Fixed Base Operator
A	USAF Parcel A	Massport	n/a	n/a	n/a	Leased from Massport by the USAF
B	U.S. Navy Parcel B	USAF	n/a	n/a	n/a	Massport actively seeking to acquire
Notes: 1. L.G. Hanscom Field 2013 General Location Plan (GLP). Does not include USAF or U.S. Navy facilities, except properties leased from Massport. 2. Not applicable (n/a) applies to unused Building ID or facilities where information was not available 3. Property condition determined from HNTB 2012 Massport Facilities Annual Report of Conditions.						

Since the 2005 *ESPR*, Massport submitted a Final Environmental Impact Report (FEIR) prepared in accordance with the Massachusetts Environmental Policy Act (MEPA) in 2007 for improvements to the Runway Safety Area and two wetland replication projects, one at the end of Runway 23 and a second west of Runway 23 and north of Runway 11. The Secretary of Environmental Affairs issued a certificate showing the FEIR complied with the MEAP scope. Construction of the RSA project began in August of

2008 and completed in 2009. The project included the re-grading Runway 05 and 23 ends so that the width of the Safety Area complied with FAA criteria, reconstructing the FAA access road that was being used by trucks hauling soil, relocating airfield fencing to improve visibility and security, and replicating wetlands impacted by the RSA improvements.

2.2.4.1 Full-service Fixed Base Operator Facilities

A full-service Fixed Base Operator (FBO) is a company that handles a range of needs for based and transient aircraft, their operators, and their passengers. Services may include cleaning, maintaining, fueling and parking, hangaring aircraft, flight planning services for the pilots, and arranging for the specific needs of passengers and flight crews, such as ground transportation or overnight accommodations. Although the majority of FBO activity involves servicing corporate GA aircraft activity, the FBOs also serve some charter activity. Typically, the corporate and charter flights that use Hanscom Field carry two to eight passengers per flight and have a flight crew of two pilots, and occasionally one flight attendant. FBO activity is heavily influenced by the business day. The majority of flights departs between 7:00 and 9:00 a.m. and returns the same day between 3:00 and 7:00 p.m. on weekdays. Saturday is typically the lightest day of the week. Occasionally, activity resumes Sunday afternoon with departures in support of the following workweek.

Hanscom currently has two full-service FBOs, which are Jet Aviation and Signature Flight Support. These FBOs are open from 6:00 or 7:00 a.m. to 11:00 p.m. and are staffed in two shifts. In the mid-1980s, Jet Aviation constructed a 40,000 square-foot (sf) FBO facility adjacent to the T-hangars located at the southwest corner of the Terminal Area. Jet Aviation added 34,000 sf of hangar space to this facility in 2001. In the same vicinity, Jet Aviation operates a fuel farm and leases Hangar 17, which is 21,315 sf. In addition to supplying corporate flights with these services, Jet Aviation also provides services for Linear Air. Linear offers on-demand air taxi service and shared charter services (purchase seats) limited to four roundtrips per week. Office staff for Linear Air is located on the third floor of the Civil Air Terminal and at Signature. Linear Air is serviced by on-airport FBO facilities.

The Signature 38,000 sf hangar is located next to the Civil Air Terminal. The hangar was constructed by the Mercury Air Group in 2001. In addition to its primary hangar, Signature leases Hangar 10 which is approximately 20,000 sf in size. Signature also leases three hangars on the East Ramp: Hangar 1 at 28,376 sf and Hangars 2 and 3 at 36,000 sf each. The buildings are primarily used for aircraft maintenance and storage with some area available for general office activities. Signature also has a fuel farm on the East Ramp.

In January 2012, the Massport Board approved a developer, Rectrix, for FBO facilities at Hanscom Field and the Worcester Regional Airport. The Rectrix Aerodrome Center at Hanscom is currently under development, which will include a 60,000 sf hangar, 7,000 sf tenant office space, and 22,000 sf, two-story FBO. It is expected that the construction will be completed in the first quarter of 2014. Rectrix' new Worcester FBO facility is also under construction in 2013 and is expected to be completed in 2014.

2.2.4.2 Aircraft Maintenance Facilities

An aircraft maintenance facility provides service and repairs to aircraft including engines, flight instruments, interiors, and structural components. These services are provided on both a scheduled and as-needed basis to locally-based and transient aircraft. Both of the above-mentioned FBOs at Hanscom provide aircraft maintenance, as does Nagle Aircraft Services.

In 2002, Nagle Aircraft Services completed construction of a 14,300 sf hangar, Hangar 12, on the east side of the Terminal Area. This hangar replaced an 8,100 sf Nagle hangar that was removed in order to accommodate the new FBO hangar constructed by Mercury Air Group in 2001, which is now occupied by Signature. Since the 2005 *ESPR* was completed, Hangar 24, located in the Pine Hill area, was redeveloped by Rectrix Aviation and will become the airports third FBO. Completion is expected in early 2014. Additionally, Massport removed the above-ground storage tanks (AST) that were located at Hangar 10.

2.2.4.3 Corporate/Conventional Hangars

Corporate and conventional hangars are generally large, open span hangars for storage of one or multiple aircraft. Corporate hangars at Hanscom Field are designed to accommodate larger turbo prop or small jet aircraft that are used for business or commercial operations.

There are three active corporate and conventional hangars at Hanscom. The three active hangars include a 15,608 sf Hangar 11 and a 26,250 sf Hangar 11A both located on the east side of the Terminal Area, and a 37,800 sf Hangar 16 on the west side of the Terminal Area. Construction of Hangar 16 was completed in 2005. It replaced a 6,225 sf hangar on this site previously occupied by Executive Flyers Aviation (a flight school), and a vacant 18,000 sf hangar. These hangars are used by corporate entities to support their flight departments or businesses. Most corporate hangars include office or storage space to accommodate the needs of those entities that are using the hangar.

2.2.4.4 T-Hangars

T-hangars are smaller than corporate and conventional hangars and offer private storage for GA aircraft. The name refers to the shape of each unit, which affords the most efficient space storage for small, individual aircraft (see Figure 2-2). Six T-hangar buildings with 12 individual T-hangar units each are located in the southwest portion of the Terminal Area. These are commonly referred to as the "Old Ts." Each individual hangar unit contains approximately 1,344 sf of space and can accommodate one small aircraft. Since 2005, funding has been allocated for roof and pavement repairs on the Old T-Hangars and the Pine Hill T Hangars, and repairs to the Pine Hill T-hangar roofs were completed. Corporate and conventional hangars may also include office or storage space.

On the southwest side of the airfield in the Pine Hill Area, there are three T-hangar buildings commonly referred to as the "Pine Hill Ts." These were constructed in 1986. One building has 18 units and the second has 12 units. Each unit in these buildings is 1,312 sf and can accommodate single-engine aircraft. The third building has eight 1,886 sf units. The larger units can accommodate light to medium twin-engine aircraft.

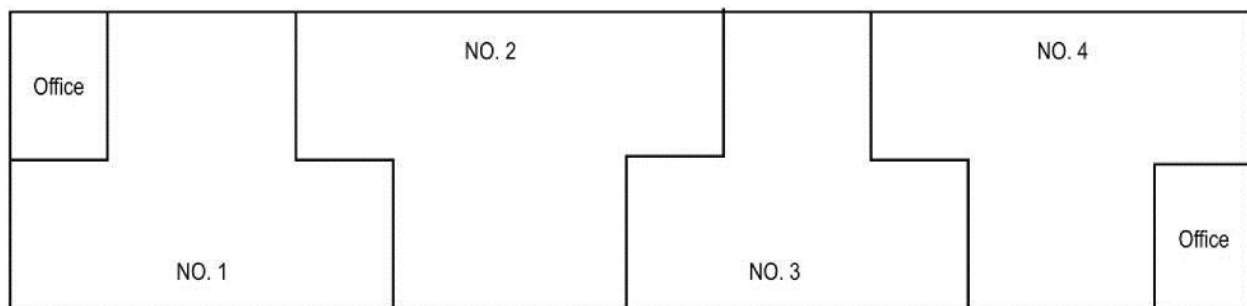


Figure 2-2 Standard T-Hangar Layout

2.2.5 Flight Schools

Flight schools provide flight training to individuals learning to fly aircraft. Training is provided in classroom facilities as well as in an aircraft with a certified instructor. Many flight schools also offer aircraft rentals to current, qualified pilots. Currently, two flight schools at Hanscom operate out of the Civil Air Terminal: East Coast Aero Club and Executive Flyers Aviation. Both flight schools use the tie-down facilities (areas on an airport specifically designed for the outdoor storage of aircraft) on the East and West Ramps for aircraft storage.

2.2.6 Technical School Facilities

National Aviation Academy (NAA) operates a technical school at Hanscom that provides aircraft maintenance training. The program includes FAA-approved courses that combine classroom and hands-on training in aircraft systems. Currently, there are approximately 200 students actively enrolled at the NAA, which is located in Hangar 12A. The Hanscom campus specializes in aeronautical maintenance technology.

2.2.7 Commuter Services

Commuter service is not currently offered from Hanscom Field. The previous operator, Streamline Air, which commenced operations on April 4, 2011, suspended service in September 2012. Linear Air, an air-taxi operator, initiated on-demand air taxi and shared charter service at Hanscom Field in January 2005, as described in the full-service FBO Facilities section in this chapter.

2.2.8 Other Aviation-related and Ancillary Businesses

In addition to the services referenced above, there are varieties of mostly aviation-related businesses that operate out of offices located in the Civil Air Terminal or the FBOs. These range from Boston MedFlight to aviation insurance to a variety of ancillary services such as car rental agencies and food services.

2.2.9 Civil Air Terminal

The three-story Civil Air Terminal building has a total gross floor area of approximately 36,000 sf, consisting of space for passenger holding areas, public seating, security checkpoint improvements, general office space, flight schools, rental agencies, food service, and Massport administrative offices. In 2011, Massport completed the installation of a new Access Control System at the Civil Air Terminal and various airfield gates. The new system enhances security by incorporating physical controls and electronic surveillance. The transition to the new system included issuing new security badges to over 1,700 badge holders. As described in Section 2.3, Infrastructure, the Civil Air Terminal is served by a one-way frontage road with drop-off and pick-up lanes, sidewalks, and pedestrian crossing to the general parking lot.

2.2.10 Aircraft Parking Areas

Aircraft that are not kept inside hangars are parked on apron areas. Aprons are open, paved spaces that provide no shelter from the elements. Small aircraft are tied down with anchors provided for securing aircraft.

Spaces for aircraft parking are located at the East Ramp, and the West Ramp. The West Ramp includes areas to the east, west, and north of the Civil Air Terminal. The East Ramp abuts the Hanscom AFB. This ramp is comprised of approximately two million sf of gross apron space. Approximately 850,000 sf are

used for aircraft tie-downs. The remainder is currently used for taxiway access and other transient aircraft parking for civilian and military aircraft. In 2006, Massport completed an East Ramp Overlay project that rehabilitated a section of pavement on the ramp as part of the ongoing East Ramp rehabilitation program.

2.2.11 Fire Fighting and Police

Massport contracts with the Hanscom AFB Fire Department to meet FAA Aircraft Rescue and Fire Fighting (ARFF) requirements. The emergency responder facilities are located at the airport on the East Ramp. The Massachusetts State Police is located inside the Civil Air Terminal and provides policing and law enforcement services for the civil side of Hanscom.

2.2.12 Miscellaneous Terminal Support Facilities

Additional terminal and general airport support facilities exist at Hanscom, including fuel storage and airfield maintenance facilities. The two FBOs store and dispense fuel for civil and military aircraft.⁴ Hangar 16 has fuel storage facilities. The ASTs at Hangar 10 have been removed. Massport stores its maintenance vehicles, including trucks, snowplows, construction equipment, and other general maintenance equipment outside or in an 11,300 sf Airfield Maintenance Building located adjacent to the FAA ATCT. A fuel farm used for Massport vehicles is also located at the facility. The Rectrix fuel farm is under development and will be located southwest of the existing Jet Aviation fuel farm facility. Massport also has a 2,500 sf Maintenance Building with carpentry shop space located at the south end of the Civil Air Terminal parking area.

2.3 Infrastructure

Hanscom is served by an infrastructure system of transportation and utility facilities. Roadway conditions are described generally below, with more detail provided in Chapter 6, Ground Transportation. In the *2005 ESPR*, a detailed inventory of parking areas was conducted to describe the number and location of spaces. Updates provided by site personnel have been used to prepare the *2012 ESPR*. Information regarding the water distribution system's supply and demand and the wastewater system serving Hanscom is based upon information in the *1995 GEIR*, the *2000 ESPR*, plus updates provided by Massport. Information regarding the stormwater management and drainage system is based on the *1995 GEIR*, *2000 ESPR*, *2005 ESPR*, the Stormwater Pollution Prevention Plan (SWPPP) and updates supplied by Massport.

2.3.1 Surface Access Roadways

Hanscom Drive provides the primary access to the Massport facilities on Hanscom Field. Hanscom Drive intersects with Route 2A, which in turn provides connections to Route 128/I-95. These designated state and federal highways form the main surface transportation connections to points north, east, and south of the airport. Route 2A also provides connections to Route 2 origins and destinations to the west. Old Bedford Road, which intersects with Hanscom Drive at the entrance to Hanscom Field and Virginia Road, provides connection to Routes 4, 225, and 62.

Hanscom Drive is a paved, four-lane divided roadway from Route 2A that provides access to Hanscom Field and the Hanscom AFB. After crossing Old Bedford Road, Hanscom Drive becomes an undivided two-lane roadway providing access to the Civil Air Terminal, the main parking lot, and other facilities in the Terminal Area of the airport.

Hanscom Drive feeds into a two-lane roadway around the perimeter of the main lot. The roadway is one-way in front of the Civil Air Terminal with designated areas for passenger drop-off and pick-up, taxis, and bus stops. In general, this roadway is in good condition, and the capacity of the roadway is adequate to meet its internal circulation needs.

2.3.2 Automobile Parking

Hanscom has adequate parking facilities for its current level of activities. The number of parking spaces available at Hanscom, including marked and unmarked spaces in the lot south of the Civil Air Terminal and at other locations around the airport, now numbers 1,667. Massport manages the parking inventory at Hanscom and from time to time relocates and reassigns the use and location of parking spaces.

Table 2-2 summarizes available parking by facility. The 2012 *ESPR* inventory represents an approximate three percent increase over the results that were reported in the 2005 *ESPR*. The increase includes the introduction of 18 lined spaces at the Storage Building, the addition of 28 spaces at Rectrix, and the addition of 10 spaces at T Hangar J. Ten spaces were also removed from Hanscom from various locations between 2005 and 2012.

Parking is also available on property that the USAF formerly leased from Massport in the North Airfield Area. There are 410 spaces in USAF Parcel B. This includes 278 spots next to the former U.S. Navy hangar and 132 spots for 66 of the former residential trailers.

Table 2-2 Summary of Vehicular Parking Spaces

2005 GLP No. ¹	Facility ²	Primary User ²	Number of Parking Spaces ²			Comments
			2000	2005	2012	
1	Hangar 1	Signature Flight Support	37	37	37	
2	Hangar 2	Signature Flight Support	20	20	20	
3	Hangar 3	Signature Flight Support	22	22	20	
7	Field Maintenance Building	Massport	18	18	18	
8	Air Traffic Control Tower	FAA	93	107	107	
9	Storage Building	FAA	n/a	n/a	18	striped spaces
9A	Sand Storage Building	Massport	n/a	0	0	2,500 sf constructed in 2005
10	Hangar 10	Signature Flight Support	64	64	64	
11	Hangar 11	NorthStar Facilities	34	34	34	
11A	Hangar 11A	Stream Enterprises	25	25	25	
12	Hangar 12	Nagle Aircraft	12	12	12	
12A	Hangar 12A	National Aviation Academy	57	57	57	
13	Hangar 13	Signature Flight Support	12	15	15	
14	FBO Facility	Signature Flight Support	10	10	10	
15	Civil Air Terminal Building	Massport	701	667	667	Restriping of parking lot
16	Hangar 16	Liberty Mutual	11	45	45	2000 includes only Hangar 3 spaces
17	Hangar 17	Jet Aviation	25	25	25	
18	Classroom	National Aviation Academy	0	0	n/a	Building demolished 2012

2005 GLP No. ¹	Facility ²	Primary User ²	Number of Parking Spaces ²			Comments
			2000	2005	2012	
19	n/a	n/a	n/a	n/a	n/a	
20	Maintenance Building	Massport	23	23	23	
21	Hangar 21	Jet Aviation	142	142	142	
22	FBO Garage and Fuel Farm	Jet Aviation	0	0	0	
23	Draper Lab	Draper Lab	n/a	17	17	Small lot not assessed in 2000
24	Hangar 24	Rectrix Aerodrome Centers	42	42	70	New building and tenant on parcel scheduled for completion in 2014
25	Draper Lab	Draper Lab	26	26	26	
26	FAA Localizer	n/a	n/a	n/a	n/a	
27	FAA Glide Slope	n/a	n/a	n/a	n/a	
28	FAA Glide Slope	n/a	n/a	n/a	n/a	
29	FAA Localizer	n/a	n/a	n/a	n/a	
30	Customs Trailer	U.S. Customs	0	5	5	
31	T-Hangar Row A	Massport	12	12	12	
32	T-Hangar Row B	Massport	12	12	12	
33	T-Hangar Row C	Massport	12	12	12	
34	T-Hangar Row D	Massport	12	12	12	
35	T-Hangar Row E	Massport	12	12	12	
36	T-Hangar Row F	Massport	12	12	12	
37	T-Hangar Row G	Massport	8	8	8	
38	T-Hangar Row H	Massport	12	12	12	
39	T-Hangar Row J	Massport	18	18	18	
40	Electric Vault	Massport		0	0	
41	Residence	Massport	n/a	n/a	n/a	
42	Residence	Massport	n/a	n/a	n/a	
43	Residence	Massport	n/a	n/a	n/a	
44	Residence	Massport	n/a	n/a	n/a	
45	FBO Fuel Farm	Signature Flight Support	0	0	0	
Total			1,484	1,523	1,557	
Adjustments based upon 2005 ESRP ³ :						
Hangar 16			32	-		
Draper Labs/Pine Hill T-Hangar Lot			17	-		
Customs Trailer			5	-		
USAF Parcel B (formerly leased property) ⁴					410	
Total with Adjustments			1,538	1,523	1,967	
Notes:						
1. L.G. Hanscom Field 2005 General Location Plan (GLP). The parking inventory in this table includes facilities owned by the USAF or U.S. Navy or properties formerly leased from Massport by the USAF.						
2. Not applicable (n/a) applies to unused Building ID or facilities where information was not available.						
3. These adjustments were verified during the development of the 2012 ESRP by Hanscom Field and Massport personnel.						
4. While these parking spaces are new to Hanscom, they were pre-existing spaces utilized by the USAF.						

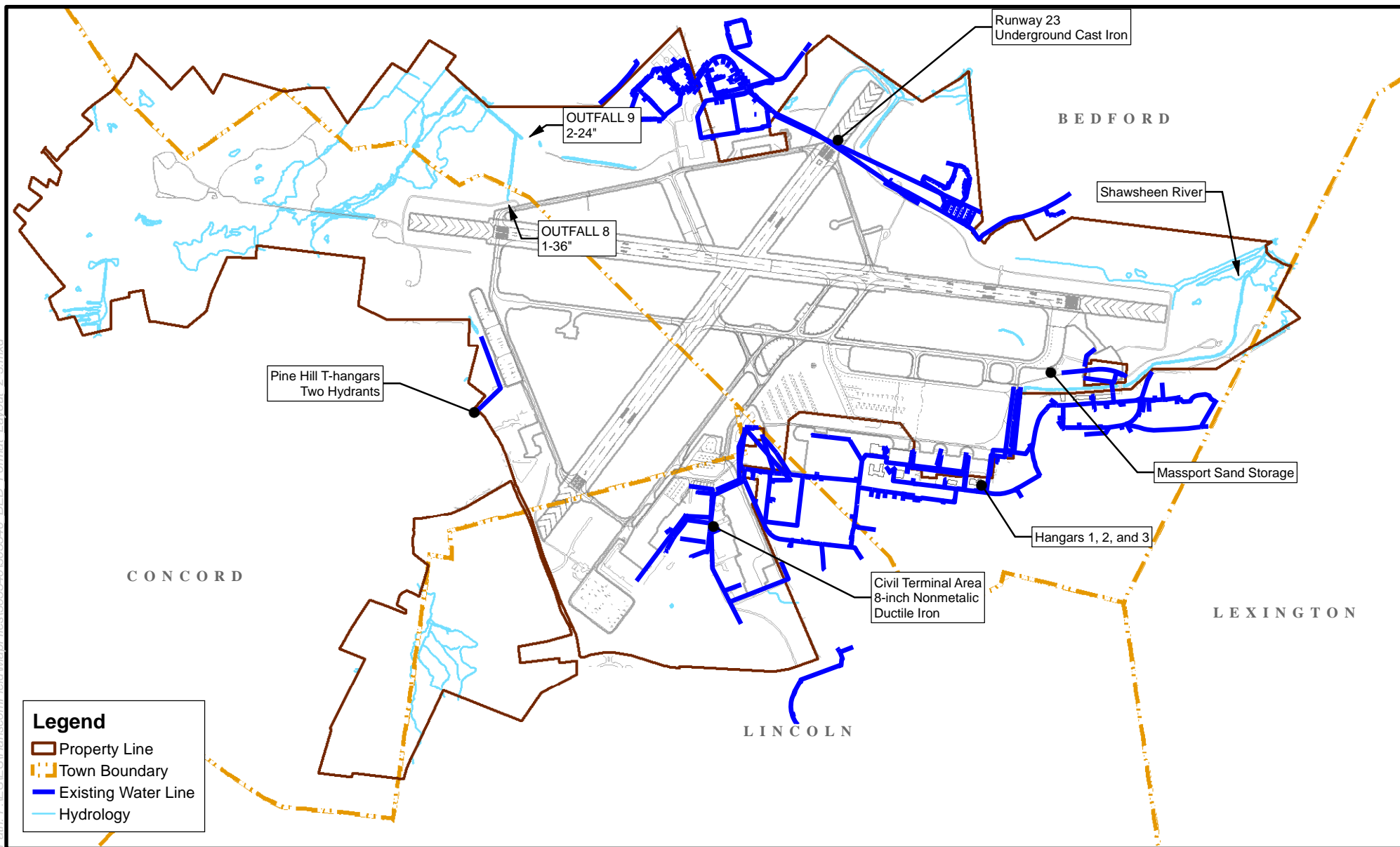
2.3.3 Water Supply and Demand

Information regarding the water supply and demand is based upon the 1995 *GEIR* and 2000 *ESPR* and the “Water System Improvements Study: Hanscom Field” (Metcalf & Eddy, 1992), water meter readings from 1996 through 2005, and further input from Massport. A history of water usage from 1988 to 2012 is provided in Table 2-3. Figure 2-3 shows the Massport water distribution system.

Table 2-3 History of Water Usage from 1988 to 2012

Fiscal Year	Gallons per Day
1988	11,250
1989	10,000
1990	13,100
1991	n/a
1992	n/a
1993	n/a
1994	13,600
1995	10,700
1996	10,000
1997	7,100
1998	9,900
1999	8,930
2000	15,790
2001	14,470
2002	23,940
2003	30,820
2004	25,340
2005	34,800
2006	11,813 (includes only USAF Main)
2007	11,907
2008	14,979
2009	12,920
2010	10,818
2011	13,997
2012	16,180

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0 1,600 3,200 Feet



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Existing Water System

Massport's water supply is provided primarily by the adjacent Hanscom AFB water distribution system. The USAF purchases its water from the Town of Lexington, which in turn is supplied by the Massachusetts Water Resources Authority (MWRA). Massport's needs are met through the Hanscom AFB connection, except for a line from the Town of Concord for the Pine Hill Area.

The USAF has an agreement with the Town of Lexington to purchase up to two million gallons of potable water per day. According to USAF personnel, the combined Hanscom Field and Hanscom AFB daily demand rarely exceeds one million gallons per day. The Town of Lexington has available capacity in its lines and the allocation for the Hanscom AFB from the town remains intact. The supply from the Town of Lexington is via a 10-inch main located along Wood Street. Depending upon demand, water flows directly into the Hanscom AFB distribution system. The water line provided by the Town of Concord runs from a water main located along Virginia Road to the Pine Hill Area facilities.

The Massport water mains vary in size (6, 8, or 12 inches in diameter) and composition (cast iron, ductile iron, asbestos cement, and polyvinyl chloride). Massport conducted extensive water distribution system testing in 1991. The test results revealed the water system pipes and other components to be in good condition, passing pipe leak testing and hydrant flow tests at maximum daily flows. The existing Hanscom Field water system is estimated to support a total average daily demand of 65,500 gallons per day (gpd).

The Massport water distribution system primarily serves the Terminal Area, Pine Hill Area, and the East Ramp Area. The Hanscom AFB system can provide a maximum flow rate of 1,500 gallons per minute (gpm) at 20 pounds per square inch (psi) at the master meter that supplies the Terminal Area. The East Ramp has a separate connection to the Hanscom AFB system. The Hanscom AFB system includes approximately 22 hydrants for firefighting purposes. Twenty of these hydrants are fed from the USAF water distribution system and two are fed from the Town of Concord. These hydrants are all located strategically near the major buildings and hangars. The fire flow assessment for each area is described in Table 2-4.

2.3.4 Sanitary Sewer System

Table 2-5 provides average daily wastewater flows at Hanscom Field. Figure 2-4 shows Massport's existing sewer system, the location of the septic system serving Lincoln North, which is sited on Massport land west of the Terminal Area, and the septic system used in the Pine Hill Area.

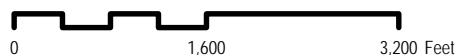
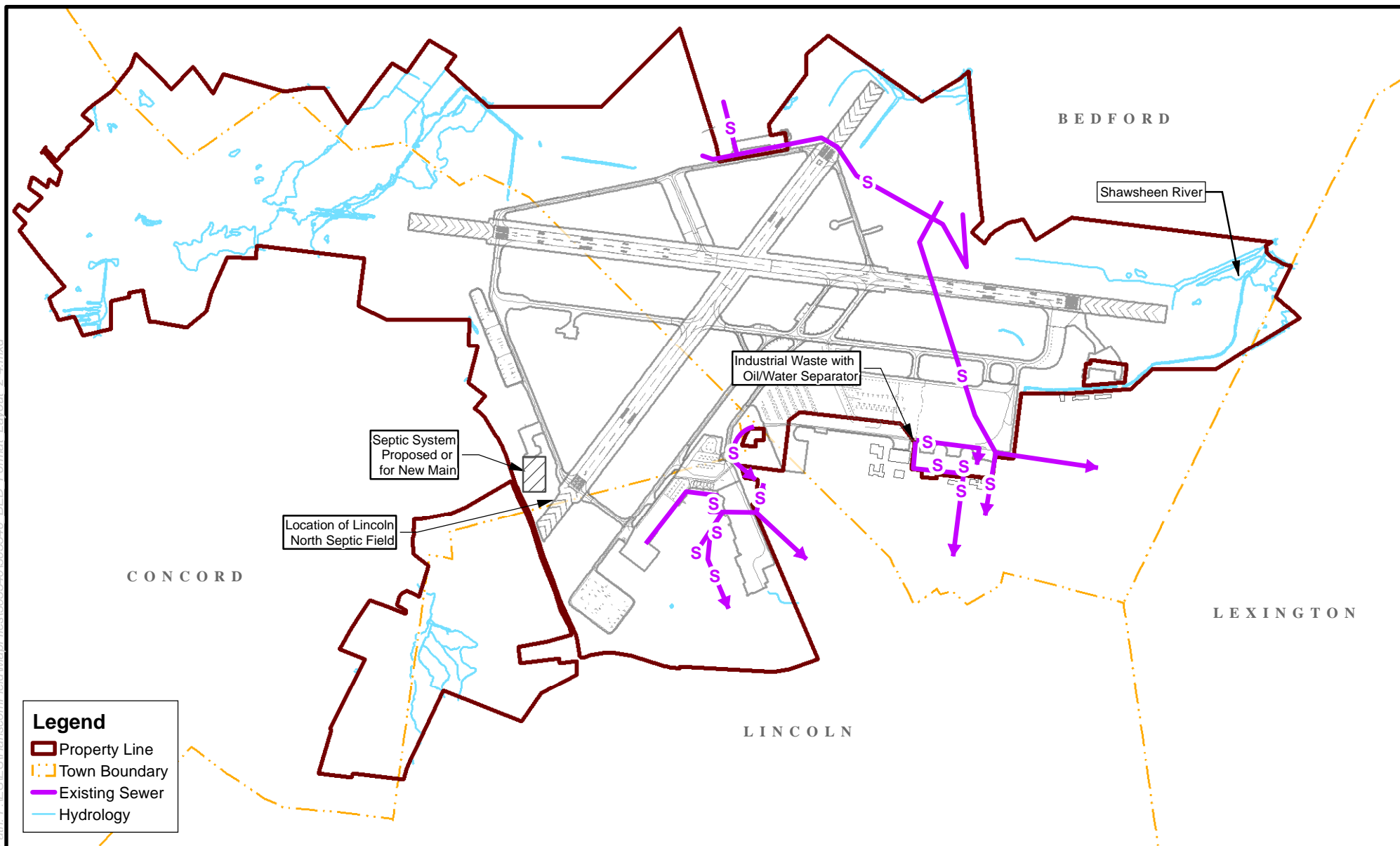
Table 2-4 Existing System Fire Flow Modeling

Area/Facility	Available Fire Flow at 20 psi (gpm)
Terminal Area	
Civil Air Terminal	1,410
Hangar 11	1,160
Hangars 1 & 3	1,230
Hangar 10	1,020
Hangar 12A	1,230
Hangar 2	1,150
Old T-Hangars	990
MPA Maintenance Buildings	1,460
Pine Hill Area	1,500
East Ramp Area	2,000
Hangars 1, 2, and 3	2,000
FAA Storage Facility	Not Available

Source: Massport

Table 2-5 Average Daily Wastewater Flow

Fiscal Year ¹	Gallons per Day ¹
1988	7,900
1989	7,000
1990	9,200
1992	n/a
1993	n/a
1994	n/a
1995	7,500
1996	7,000
1997	4,970
1998	6,930
1999	6,250
2000	11,050
2001	10,130
2002	16,760
2003	21,570
2004	17,740
2005	24,360
2006	8,269
2007	8,335
2008	10,485
2009	9,044
2010	7,573
2011	9,798
2012	11,326
1. Flows south to the Massachusetts Water Resources Authority System. Wastewater leaving the site is estimated to be 70 percent of water usage (see Table 2-4). This reflects some on-site septic systems that do not tie into the MWRA	



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Existing Sanitary Sewer System

Massport's wastewater system discharges into the Hanscom AFB wastewater system, which in turn discharges into the MWRA wastewater system through the Town of Lexington. The USAF has two pump stations on base: the lower station at Building 1539 and the upper station at Building 1306. The lower pump station, upgraded in 1983 with three 40-horsepower (HP) pumps, has a capacity of 1,000 gpm and serves Massport's Hanscom facilities and Hanscom AFB housing. The upper station receives flow from the lower pump station as well as the Officers Club, Lincoln Laboratory, and MITRE. The upper station was upgraded in 1987 and is equipped with two 800 gpm (40 HP) pumps, one 1,500 gpm (125 HP) pump, and two wet wells with a combined storage capacity of 250,000 gallons.

The flow from the upper station is pumped to a 10-inch force main that discharges wastewater to a force main along Hartwell Avenue. This main connects to a 20-inch force main from the Town of Bedford near the intersection of Hartwell Avenue and Bedford Street. The capacity of the force main leaving the Hanscom AFB is 1,725 gpm but use is limited to 1,500 gpm in keeping with the USAF's agreement with the Town of Bedford and the MWRA.

Massport's wastewater system was initially constructed in the 1950s. The system underwent expansion in the 1970s and 1980s to service new facilities. It was upgraded in 1994 in the Terminal Area. The upgraded pipe network, along with upgrades to the manholes in the same area, eliminated a problem of infiltration and inflow. According to the "Water System Improvements Study," the on-site 6-inch and 8-inch vitrified clay pipes have capacities of 230,000 gpd and 500,000 gpd respectively. Neither is currently near full capacity. Additionally, the Supplement to Site Development Plan and Design Guidelines by Greiner Engineering Services, Inc. (1987) states, prior to the lower pumping station on the Hanscom AFB, the system expands from an 8-inch to a 12-inch line with a capacity of 1,045,000 gpd.

2.3.5 Stormwater Management and Drainage System

Hanscom Field is located in the Shawsheen River Basin. Runoff from Massport property and the USAF property is conveyed by open channels and a closed storm drainage system. The system discharges directly and indirectly into the Shawsheen River to the east, Elm Brook (a tributary to the Shawsheen) to the west, and wetlands to the north of the site. Most of the soil types on Hanscom Field are classified as Hydrologic Soils Group C. This soil type is characterized by a slow rate of infiltration after the soils have become saturated during long duration storm events and high groundwater levels.

Hanscom Field employs an extensive drainage system that was designed and constructed in the early 1950s when the USAF enlarged and improved the airfield. The system was expanded and modified over the ensuing years to serve the additional development. The storm drainage system consists of a series of catch basins placed along most of the edges of the runways, taxiways, and apron areas. The stormwater system's original design, containing pervious bottom catch basins and perforated/open jointed pipes, was intended to drain groundwater as well as convey surface water away from the airfield's paved surface and infield areas. The collection system conveys stormwater and groundwater to eight outfall locations and two overland flow areas that in turn discharge directly or indirectly into the Shawsheen River.

Massport has been working cooperatively with the Massachusetts Department of Environmental Protection (MassDEP), the U.S. Environmental Protection Agency (EPA), and the USAF to improve the flow characteristics and profile of stormwater discharges into the Shawsheen River. Massport has removed pavement to decrease impermeable areas on the airfield and has incorporated water quality and water quantity improvements into ongoing projects using Low Impact Development (LID) technologies. Massport has also taken measures to control stormwater discharges into the river directly. For example,

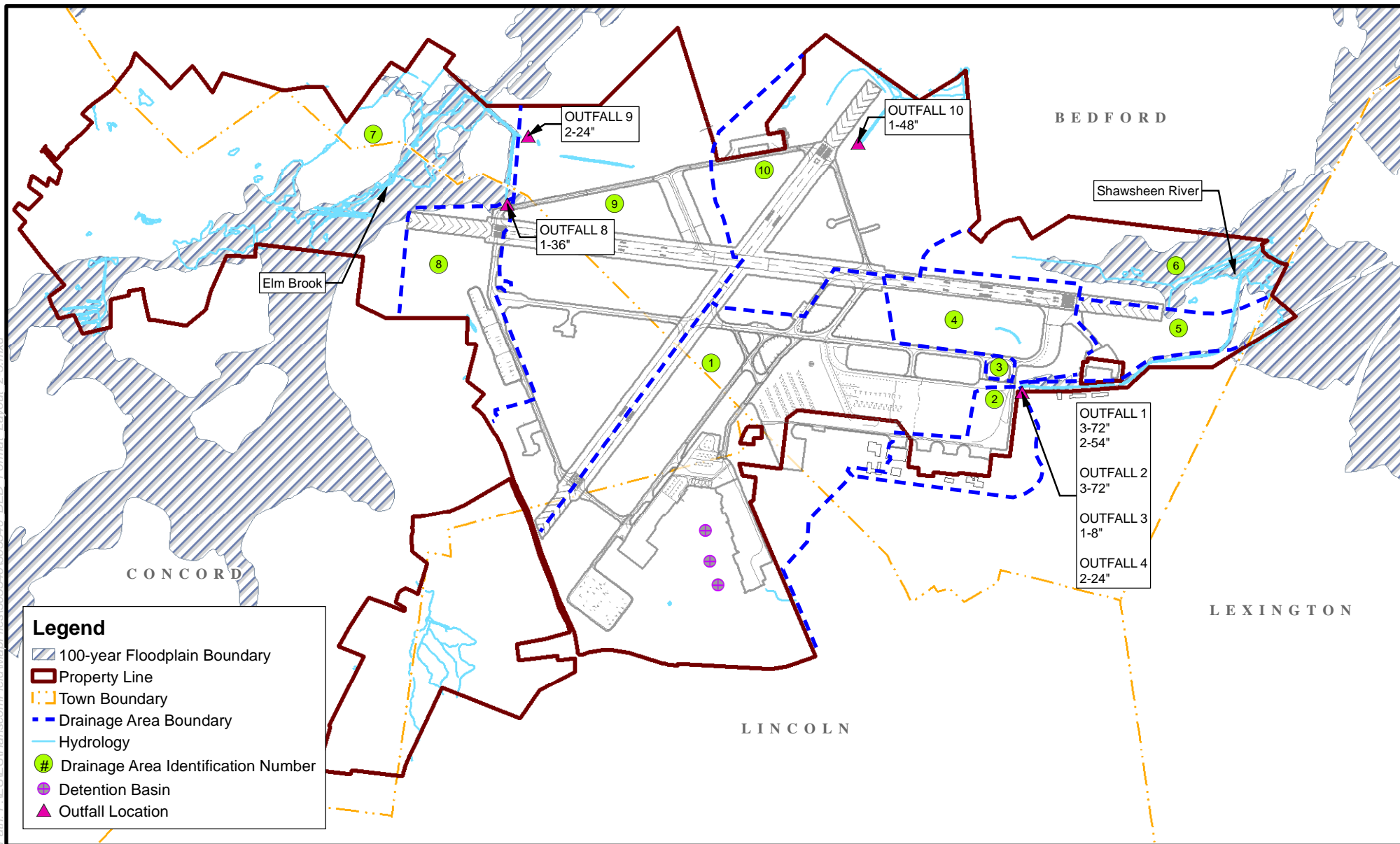
overflow weirs for temporarily storing water were installed in three large drainage pipes leading to the Shawsheen River in 2006. The weirs were designed to reduce the peak discharge of stormwater and increase base flow by releasing the stored water over time. In 2007, Massport prepared a computer model to evaluate potential stormwater improvement projects at Hanscom Field or on Hanscom AFB. An important goal of the work was to develop a system for determining which stormwater improvements would be of the greatest benefit to the Shawsheen River. In 2008, Massport had silt and sand removed from portions of three storm drainpipes just upstream from the Shawsheen River, and an additional weir was installed in a large collection chamber to reduce peak flow during a storm event. A new structure was also constructed in an infield area to reduce the amount of flow entering a culvert. In 2009, Massport completed soil permeability testing related to the potential installation of additional stormwater structures designed to increase groundwater recharge and decrease runoff.

In 2010, in compliance with the National Pollutant Discharge Elimination System (NPDES) Stormwater Multi-Sector General Permit, Massport updated its SWPPP to include best management practices for stormwater management and snow removal. All programs and audits were implemented during 2010.

Massport and the USAF continued joint discussions with MassDEP regarding the Shawsheen Watershed Initiative. In 2011, Massport received internal approval to proceed with a plan for future improvements to the Shawsheen River headwaters, to be completed jointly by Massport and the USAF. With approval from MassDEP, Massport and the USAF are jointly developing a new, more comprehensive computer model to assess how various stormwater recharge structures and best management practices could improve base flow. This model will be used to guide the future implementation of stormwater best management practices at both Hanscom Field and Hanscom AFB.

Hanscom Field is divided into ten separate drainage areas encompassing on and off-site tributaries totaling approximately 1,216 acres. Table 2-6 lists the volume of stormwater that is projected to occur during specific storm events under existing conditions for the ten drainage areas that are illustrated in Figure 2-5.

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0 1,600 3,200 Feet



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Drainage Area, Outfall Locations,
and Floodplain Boundary

Figure 2-5

Table 2-6 Hanscom Field Runoff Summary

Basin/ Discharge Location ¹	Drainage Area (Acres)	Percent Impervious ²	Storm Event Runoff (Cubic Feet per Second)				
			2 Year	5 Year	10 year	25 Year	100 Year
Shawsheen River							
1	312.9	62	139.5	195.8	246.4	304.8	400.4
2	37.3	99	38.1	47.9	56.4	66.2	81.9
3	2.2	45	4.1	5.9	7.6	9.5	12.6
4	53.3	36	6.3	13.2	19.2	26.6	39.5
5	33.1	36	10.4	18.1	25.6	34.9	50.9
6	75.4	36	6.8	13.2	19.9	28.5	43.8
Elm Brook							
7	242.0	0	19.4	40.2	62.8	92.3	146.3
8	51.9	42	21.7	33.6	44.7	58.0	80.4
9	237.8	24	26.8	45.1	63.0	84.9	123.0
Wetlands							
10	170.7	21	38.6	62.4	85.5	113.5	161.2
Drainage Area No.1 includes 38.9 acres of USAF property.							

Source: Massport

Drainage Area 1: Drainage Area 1 drains to three 72-inch (1A, B, and C) and two 54-inch (1D and 1E) circular storm drains that discharge to the Shawsheen River. These drains have been identified as Outfalls 1A to 1E on Figure 2-5. The five pipes collect runoff from an area of approximately 312 acres that includes land areas occupied by Massport, Signature, Jet Aviation, Sabrina Fisheries, Nagle Aircraft, Liberty Mutual, National Aviation Academy, and a portion of USAF property. Jet Aviation's fuel farm is also included in the drainage area for Outfalls 1A-1E.

Drainage Area 2: The contributing drainage area to Outfalls 2A-2C consists of approximately 37 acres from Hanscom Field, which drains into three 72-inch circular storm drains (Outfalls 2A-2C) that discharge to the Shawsheen River. These 72-inch drains also collect runoff from USAF Property (upstream of Hanscom Field), which is not included in the SWPPP. The area contributing to these outfalls includes the land occupied by the Signature hangars and its fuel farm.

Drainage Area 3: This drainage area collects runoff from a small mostly vegetated area of approximately 2.2 acres and discharges to the Shawsheen River through an 18-inch pipe (Outfall 3).

Drainage Area 4: This 53-acre tributary area drains to Outfalls 4A and 4B and includes runway and infield area that discharges through two 24-inch pipes to the Shawsheen River.

Drainage Area 5: Drainage Area 5 includes runway and infield area of approximately 33 acres that contributes runoff via an overland flow to the Shawsheen River.

Drainage Area 6: Drainage Area 6 includes runway and infield area of approximately 75 acres that contributes runoff via drainage swale to the Shawsheen River.

Drainage Area 7: This is an undeveloped vegetated area of approximately 242 acres that contributes runoff to Elm Brook via overland flow.

Drainage Area 8: This drainage area collects runoff from approximately 52 acres of runway and infield area and discharges through a 36-inch pipe (Outfall 8). The discharge flows via drainage swale (approximately 900 feet) to Elm Brook.

Drainage Area 9: This area is a 238-acre basin that contributes runoff to Outfall 9. A large portion of this area (Area B) is comprised of a runway with associated grassed infield. This area includes approximately

5.6 acres of U.S. Navy property. Rectrix and Draper Laboratory are located in this drainage area. It discharges through a 54-inch reinforced concrete pipe at a location approximately 500 feet from Elm Brook.

Drainage Area 10: Outfall 10 receives runoff from 170 acres of land that consist of runway and infield areas and includes approximately 11.4 acres owned by the U.S. Navy. This area discharges through a 48-inch reinforced concrete pipe to the wetland area north of the airport.

2.3.6 Hazardous Material Management

Drainage areas 1 and 2 contain facilities that are reported to store and use hazardous materials, including fuel oils and chemicals. Massport has developed a Spill Prevention Control and Countermeasures (SPCC) Plan that covers general Massport operations. Tenants that store a total of more than 42,000 gallons of oil in underground storage tanks (USTs) and/or more than 1,320 gallons of oil in ASTs or containers are required to have a SPCC Plan as required under 40 CFR 112 (Oil Pollution Prevention). Table 2-7 lists the hazardous materials that are likely to be present at Hanscom.

Table 2-7 Hanscom Field List of Hazardous Materials

Fuels	Miscellaneous Materials	Waste Materials	Vehicle Maintenance Materials
Jet Fuel A	Cooking oil grease	Waste mix oils	Hydraulic Fluid
Low Lead 100 Fuel	Ethylene Glycol	Battery Acid	Transmission Fluid
Gasoline	Propylene Glycol	Waste Jet Fuel	Brake Fluid
Kerosene	Paint		
Number 2 Heating Oil	Ureas		
Motor Oil	Calcium Chloride		
Turbine Oil	Sodium Formate		
Gasoline	Cleaners/Detergents		
	Parts Cleaners		
	Asbestos		

Source: Massport

Spills of hazardous materials on site must be immediately reported to the Hanscom AFB Fire Department. Notification to the National Response Center and the MassDEP is also required if the amount exceeds the Reportable Quantity threshold or enters a catch basin or drain. All spills shall be documented in writing to Massport's Operations and Environmental Departments.

Spills exceeding the reportable quantity limits established in Table 302.4 - List of Hazardous Substances and Reportable Quantities of 40 CFR 302 and Table 1 - Massachusetts Oil and Hazardous Materials List 310 CMR 40.1600, Subpart P, must be reported to the National Response Center, and the MassDEP, respectively. The limits established by these regulations for the most common materials handled at Hanscom are provided in the SWPPP, Laurence G. Hanscom Field, Bedford, Massachusetts (January, 2009; Last Updated: June 2013), along with the spill reporting contact list.

2.3.7 Floodplain

Figure 2-5 depicts the 100-year floodplain boundary for the area surrounding Hanscom according to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs) for the Town of Bedford, Panel No. 255209-005 and 006 C, effective July 4, 1988. There is no FEMA mapping done for the Hanscom Field area located within Towns of Lincoln and Concord.

2.3.8 Wellhead Protection Areas

As discussed in Chapter 9, Wetlands Wildlife and Water Resources, portions of Hanscom Field are located within the Wellhead Protection Area for three wells in Bedford (see Figure 9-4). There are no Surface Water Supply Protection Areas (Zone A, B, C) in Hanscom Field.

2.3.9 Electrical Distribution System

Hanscom Field electrical power is provided primarily by NSTAR Electric and Gas. Electrical services for facilities located in Concord are provided by Concord Municipal Power and Light (CMPL). For the most part, the civilian and Hanscom AFB electrical distribution systems are separate. The few exceptions are power supplies to some navigational aids.

The overall capacity of the electrical system is approximately 800kVA. In 1987, average annual power consumption was estimated at 600kVA (Greiner, 1987), 75 percent of total capacity. The existing system has sufficient capacity for some additional power demands by existing tenants and buildings. To meet future demands, additional electrical capacity may be required. The 5kV supply from NSTAR is small, considering the demand placed by the airfield and buildings. In 1987, the utility company considered the installation of a 13.8kV feeder to the airfield. If this occurs, the primary electrical distribution system would need to be redesigned and significantly upgraded but would provide the benefit of adequate power for long-term electrical needs.

Electricity generation is also conducted at one location at Hanscom. A solar photovoltaic array was constructed on the roof of the Civil Air Terminal in 2011. The facility has a rated capacity of 51 kW and is predicted to produce over 57,233 kilowatt-hours (kWh) of electricity per year, or 21 percent of the total building electricity requirement. For any periods when it is producing more electricity than the building requires, the electricity will flow back to the on-site distribution system for consumption by other facilities.

2.3.10 Natural Gas

Natural gas is supplied by National Grid through a 4-inch high pressure main that comes onto airport property from Route 2A along Hanscom Drive. Gas is used for heating purposes with demand peaking during the winter months. This gas service was increased from a 2-inch high pressure main in order to supply the new hangars and conversion of the Civil Air Terminal building to gas heat, and construction by the USAF of a new Commissary facility. This four-inch line can accommodate future development.

2.3.11 Telephone/Communications

Verizon Communications provides telephone service to Hanscom. Telephone service lines enter along Hanscom Drive on overhead poles to the Terminal Area. The lines then run in underground conduits, which are routed to each of the facilities at Hanscom. Telephone conduit capacities are adequate for current demands although routine service upgrades may be required to provide a sufficient number of lines for future conditions.

2.3.12 Tank Management Program

Beginning in 1993, Massport instituted a tank management program designed to track the age and physical characteristics of all Massport-owned and fuel storage tanks at Hanscom Field. The purpose of

this program is to maintain current tank information and ensure that tanks comply with the current AST and UST regulatory requirements.

In 1995, the Massport Environmental Management Unit established a database of all Massport- and tenant-owned tanks identified at Hanscom. This regularly updated database tracks more than 50 tanks that are currently in use, have been removed, or have been replaced. Information on tenant tanks is obtained from tank permits filed with the Massport Fire Department. Massport records show that its existing tanks are currently in compliance with applicable state and federal regulations. Massport will continue to monitor the condition of all active tanks to ensure proper functioning and regulatory compliance.

Since 2005, the ASTs at Hangar 10 were removed. In 2010, Massachusetts State Tank Regulations were revised, and regulatory jurisdictions are now assigned by tank size and position (above or below the ground). Storage tanks on Massport property are now regulated by various jurisdictions—ASTs of less than 10,000-gallon capacity by the Massport Fire Department, ASTs of greater than 10,000-gallon capacity by the Massachusetts Department of Fire Services, and USTs by the MassDEP. As of 2010, ASTs must be renewed annually; however, UST permits no longer expire. Active smaller ASTs, larger ASTs, and USTs at Hanscom Field are listed in Tables 2-8, 2-9, and 2-10, respectively.

Table 2-8 ASTs Less Than 10,000 Gallons at Hanscom Field

Tank ID	Owner	Location	Volume (gallons)	Content
HANAM-0042	Massport	Field lighting vault	500	D
HANAM-0073	Massport	Building 37	275	D
HANAM-0074	Massport	Building 31	110	D
HANAT-0050	Jet Aviation	380 Hanscom Drive	3,000	G
HANAT-0054	Stream Enterprises	140 Hanscom Drive	1,065	D
HANAT-0061	Signature Flight Support	East ramp	6,000	G
HANAT-0062	Signature Flight Support	East ramp	6,000	D
HANAT-0064	Signature Flight Support	NW corner of Building 13	275	D
HANAT-0071	Signature Flight Support	Hangar 1	275	HO
HANAT-0072	Signature Flight Support	Hangar 1	275	D
HANAT-0076	Liberty Mutual	230 Hanscom Drive, Building #16	200	D
HANAT-0079	Boston Medflight	Hangar 2 (in front, airside)	400	HO
HANAT-1004	Jet Aviation	Building #17, Jet Aviation	350	D
HANAT-1005	Jet Aviation	Building #17, Jet Aviation	300	WO
Tank list updated May 20, 2013 Tanks inspected annually Permit expires 1/15/2014 for all tanks D = diesel HO = heating oil G = gasoline WO = waste oil				

Source: Massport

Table 2-9 Active ASTs Greater Than 10,000 gallons at Hanscom Field

Tank ID	Owner/Operator	Location	Volume (gallons)	Content	Permit Expiration
HANAT-0047	Jet Aviation	380 Hanscom Drive	20,000	JA	1/15/2014
HANAT-0048	Jet Aviation	380 Hanscom Drive	20,000	JA	1/15/2014
HANAT-0049	Jet Aviation	380 Hanscom Drive	12,000	AG	1/15/2014
HANAT-0059	Signature Flight Support	East Ramp	15,000	JA	1/15/2014
HANAT-0060	Signature Flight Support	East Ramp	10,000	AG	1/15/2014
HANAT-0063	Signature Flight Support	East Ramp	15,000	JA	1/15/2014
HANAT-0066	Signature Flight Support	East Ramp	15,000	JA	1/15/2014
Tank list updated 1/28/13 Tanks inspected annually Permit expires 1/15/2014 for all tanks AG = AvGas JA = Jet A					

Source: Massport

Table 2-10 Active USTs at Hanscom Field

Tank ID	Owner/Operator	Location	Volume	Content
HANBM-0026	Massport	Building maintenance shop	1,000	HO
HANBM-0038	Massport	150 Hanscom Drive	6,000	HO
HANBM-0043	Massport	Field maintenance garage	6,000	G
HANBM-0044	Massport	Field maintenance garage	6,000	HO
HANBM-0045	Massport	Field maintenance garage	6,000	D
HANBT-0065	FAA	ATCT	2,500	D
HANBT-0067	Liberty Mutual	230 Hanscom Drive	25,000	JA
Tank list updated May 2013. All underground storage tanks on Massport property are permitted by Massport Fire and no longer expire. ATCT = Air Traffic Control Tower G = gasoline FAA = Federal Aviation Administration D = diesel HO = heating oil JA = Jet A				

Source: Massport

Information about Massport's Tenant Audit Program and MassDEP-listed disposal sites at Hanscom Field is provided in Chapter 9, Wetlands Wildlife and Water Resources. Site remediation was completed in 2005 for the only MassDEP-listed disposal site that was open. Massport submitted documents to MassDEP and the U.S. EPA on May 22, 2006 to bring this site to regulatory closure. A search of the MassDEP's Online 21E Site File Review database returned data indicating that there are three 21E-cases associated with Hanscom Field with notification dates in 2000, 1994, and 1993 and response action outcome (RAO) status. RAO status indicates that response actions were sufficient to achieve a level of no significant risk or at least ensure that all substantial hazards were eliminated.

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3 Airport Activity Levels

This chapter reports on aviation activity levels and trends at Hanscom Field from 2000 to 2012. Aviation activity levels form the basis of the evaluations of ground transportation, noise and air quality impacts associated with the airport. This *2012 ESPR* also provides an opportunity to re-assess the prior forecasts presented in the *2005 ESPR* and update the forecasts to reflect current conditions and industry trends. Base year (2012) traffic is compared to forecast activity from the *2005 ESPR*, and new forecasts for the mid (2020) and long-term (2030) planning horizons are presented and described. The actual operations for 2012 can also be compared with actual operations in past years to reveal activity trends. The updated forecasts are subsequently used to assess potential future ground traffic, noise and air quality impacts associated with the airport under certain planning scenarios.

Hanscom Field accommodates all segments of the general aviation (GA) industry including business and corporate aviation, air taxi/private charter services, recreational and personal flying and pilot training activities. In addition to GA, from time to time commercial passenger services have been available at Hanscom Field. The most recent such service was provided by Streamline Air from April 2011 to September 2012. This chapter reports on all aviation activities at Hanscom Field and the following traffic measures:

- Aircraft operations by type and aircraft category
- Based aircraft
- Commercial air passengers

Table 3-1 presents the 2005 and 2012 actual operations by aircraft type from 7:00 am to 11:00 pm along with forecasts prepared for the planning years 2020 and 2030.

3.1 Key Findings Since 2005

- Hanscom Field functions as a premier full-service GA airport and corporate reliever for Boston Logan Airport with limited commercial passenger service.
- There were 166,000 aircraft take-offs and landings performed at Hanscom Field in 2012. GA accounted for 99 percent of the operations.
- Nearly three-quarters of the aircraft operations are conducted with single-engine piston aircraft, including 70,200 local pilot training operations and 51,500 itinerant operations for personal or recreational purposes.
- Hanscom also serves the needs of business aviation users, including corporations that own their own aircraft and businesses that charter private flights. Business aviation operations conducted in jets, turboprops and multi-engines piston aircraft accounted for 22 percent of Hanscom's activity, or 35,800 operations.
- Streamline Air offered regularly scheduled public charter services at Hanscom from April 2011 to September 2012. Streamline's services were geared towards business travelers. Two daily roundtrips were flown from Hanscom to Trenton, New Jersey with 30-seat turboprop aircraft.

There have been no scheduled passenger services at Hanscom since Streamline Air discontinued services in 2012.

- Hanscom's total aircraft operations have declined by 2.0 percent annually from approximately 218,000 operations in 2000 to 166,000 operations in 2012. The drop in aircraft operations at Hanscom mirrors a long-term decline in general aviation activity nationally. GA suffered steep declines as a result of rising fuel prices and the economic recession in 2008 and 2009. Nationally, the GA industry has yet to recover from the downturn. GA operations at U.S. airports with air traffic control towers were down by nearly 7 percent in 2012 compared to 2009. However, GA at Hanscom Field has recovered with operations increasing by approximately 11 percent over the same period.
- Business aviation has been the fastest growing segment of activity at Hanscom Field, increasing at a long-term average annual rate of 2 percent from 2000 to 2012. After a sharp decline in business aviation following the economic and financial collapse in 2008/09, business operations have been slow to recover due to the slow pace of economic growth and economic uncertainty.
- Forecasts of aviation activity at Hanscom Field were prepared for the near-term (2020) and long-term (2030) planning periods. A key assumption underlying the forecasts is that Hanscom continues to function as a GA reliever for Logan Airport and the premier business aviation airport in the Greater Boston area with limited military and commercial airline operations.

Table 3-1 Summary of Actual and Forecast Activity at Hanscom Field

	Actual		Forecast	
	2005	2012	2020	2030
Aircraft Operations (7:00 am to 11:00 pm)				
General Aviation				
Local (SEP)	58,535	70,196	62,605	65,164
Personal Flying (SEP)	57,894	51,477	50,661	58,285
Business Non-Jet (MEP + Turbo)	9,646	10,178	10,861	12,985
Business Jet	32,345	25,638	35,043	46,782
Helicopter	7,004	7,345	7,345	7,345
Subtotal GA	165,424	164,834	166,515	190,561
Military	904	745	745	745
Commercial Scheduled Airline¹	3,627	635	1,040	1,820
Total Operations	169,955	166,214	168,300	193,126
Based Aircraft	387	340	360	416
Commercial Airline Passengers	17,457	8,609	20,280	40,600

1. Aircraft operations are tracked by the FAA daily between 7:00 am and 11:00 pm, which are the hours that the air traffic control tower is open.

Source: Massport, FAA Tower Counts, and 2005 ESPR.

- Total aircraft operations are forecast at 168,300 in 2020 and 193,100 in 2030. Long-term growth in overall aircraft operations (2012 to 2030) is expected to be modest at 0.8 percent per year. Consistent with a positive outlook for business aviation nationally, business operations are expected to increase by 2.9 percent per year reaching nearly 60,000 operations in 2030. Business jet operations are forecast to grow by 3.4 percent per year to nearly 46,800 in 2030.
- Although there is no commercial airline services offered at Hanscom today, the activity forecasts include a commercial passenger airline scenario. The forecast scenario assumes services by a small regional airline or public charter provider, similar to the recent Streamline Air operation at

Hanscom. The assumed services would target business passengers and would be operated with 30-seat turboprop aircraft. Under these assumptions, scheduled commercial airline passenger traffic at Hanscom Field is forecast at 20,300 by 2020 and 40,600 in 2030. Annual commercial airline operations are forecast at 1,040 in 2020 and 2,080 in 2030.

3.2 2012 Activity Levels at Hanscom

In 2012, there were approximately 166,000 aircraft landings and take-offs at Hanscom Field⁷. GA accounted for nearly all of the activity at Hanscom Field, with military and commercial airline activity representing less than 1 percent of the airport's operations. Commercial services provided by Streamline Airlines were discontinued in September 2012.

Nearly three-quarters (73 percent) of the operations performed at Hanscom in 2012 were in single-engine piston (SEP) aircraft (see Figure 3-1). At Hanscom, single-engine piston activity consists of training operations and recreational (or personal) flying. Training operations associated with the two flight schools are the prevailing type of aircraft operation at Hanscom Field. In 2012, more than 70,000 training operations occurred at Hanscom.

Training operations are also referred to as "local" operations by the FAA because these operations are conducted in the local traffic pattern or within sight of the airport tower or are known to be departing for, or arriving from, local practice areas located within a 20-mile radius of the airport. All other operations have an arrival or departure outside the local traffic pattern and are considered "itinerant." Operations that are itinerant may be performed by aircraft that are based at Hanscom or based at other airports.

Recreational flying in single engine piston aircraft is the second most prevalent type of aircraft activity at Hanscom. In 2012, there were approximately 51,500 recreational operations conducted by single engine piston aircraft.

Hanscom Field also serves the needs of business aviation users, which include corporations that own and operate their own aircraft. These users may have aircraft that are based at Hanscom or their aircraft may be based at other airports, either in the region or across the globe. Business aviation users also include on-demand air taxi and charter operators that provide private air transportation services for hire or fractional aircraft operators whose customers own a share of an aircraft and are guaranteed a certain number of air transportation hours per year. In 2012, Hanscom accommodated approximately 35,800 business aviation operations, which represents 22 percent of total operations. Business aviation activity includes operations in jet and non-jet aircraft, such as multi-engine pistons (MEP) and turboprops (TP).

Helicopters based at Hanscom Field provide medical and other emergency transportation services and private charter operations. In 2012, helicopters performed 7,300 operations, which represent approximately 4 percent of Hanscom's total operations. Military operations account for less than one half percent of Hanscom's aircraft activity. In 2012, there were 745 operations in military aircraft.

⁷ Massport's official aircraft operation counts are based on the FAA Air Traffic Control Tower (ATCT) counts from 7:00 am to 11:00 pm when the tower is operational. In 2012, there were 1,631 additional aircraft operations during the late night/early morning hours when the tower is closed. The nighttime operations presented in the 2012 ESPR differ slightly from those published in the Hanscom Field Annual Noise Report. This discrepancy is due to the difference in the timing of the preparation for the two reports. Each report used the best available data at the time of the analysis for that report. The difference of approximately 0.3 daily nighttime operations or 0.07% of all daily operations would change computed noise levels by less than 0.1 dB, which is imperceptible and would not change the analysis presented.

In 2012, Streamline Air offered regularly scheduled public charter services between Hanscom Field and Trenton Mercer Airport in New Jersey with 30-seat Embraer Brasilia turboprops. Services were geared toward the business traveler and were operated on weekdays with up to two departures per day. Streamline Air which began serving the Hanscom market in April 2011, discontinued services in September 2012. From January through September, Streamline conducted 635 operations and had 8,600 passengers (enplaned plus deplaned) at Hanscom Field.

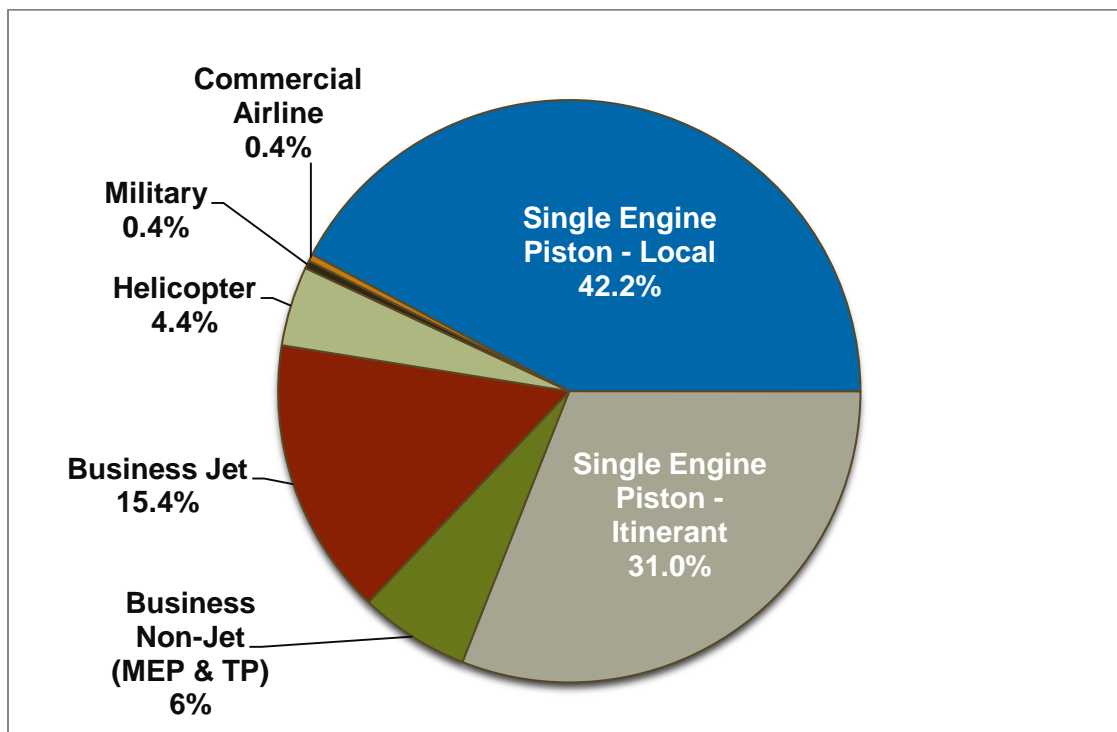


Figure 3-1 Hanscom Field Aircraft Operations by Type and Aircraft Category

Source: Massport

3.2.1 Comparison of 2005 ESPR forecast to actual 2012 activity

All long-term aviation forecasts are subject to uncertainty. A variety of unforeseen external factors can positively or negatively impact airport traffic levels and lead to discrepancies between forecast and actual activity levels. There have been a number of such unpredictable external shocks over the past several years that have affected aviation both locally and nationally.

Table 3-2 compares actual 2012 activity levels at Hanscom to predicted 2012 levels based on the 2005 *ESPR* forecasts. Predicted 2012 activity levels were interpolated based on the 2010 and 2020 forecasts presented in the 2005 *ESPR*. Hanscom's actual aircraft operations for 2012 were lower than the activity levels based on the 2005 *ESPR* forecasts by 32,000 to 47,000 for the Moderate and High scenarios, respectively (see Table 3-2). The largest discrepancies are in the personal flying and business jet categories. Compared to the 2005 projections, there were 8,000 to 20,000 fewer itinerant operations in single-engine piston aircraft and 25,000 to 34,000 fewer operations in business jet aircraft. Both of these activity segments were negatively impacted by higher fuel prices, which have more than doubled since 2005, as well as the 2008/2009 economic recession and slow pace of economic recovery, which depressed demand for private air transportation.

In addition, the global financial collapse had a negative impact on the per-seat on-demand air taxi model that was predicated on the use of new, low-cost very light jets like the Eclipse. When the 2005 *ESPR* forecasts were being developed, there were several new entrant air taxi operators like DayJet and Pogo, which were forecast to transform the industry and lead to higher growth in business jet activity. However, these companies were unable to obtain needed financing to launch their operations and they ultimately collapsed. Nationally, actual growth in business jet activity between 2005 and 2012 was much lower than predicted by industry analysts and the FAA.

Table 3-2 2005 *ESPR* Forecast and Actual 2012 Activity at Hanscom Field

	2005	2012	2005 <i>ESPR</i> Forecast for 2012		Actual vs. Forecast			
			Moderate	High	Net Difference		Percent Difference	
					Moderate	High	Moderate	High
Aircraft Operations								
General Aviation								
Local (SEP)	58,535	70,196	64,178	52,360	6,018	17,836	9.4%	34.1%
Personal Flying (SEP)	57,894	51,477	59,274	71,158	(7,797)	(19,681)	-13.2%	-27.7%
Business Non-Jet (MEP + Turbo)	9,646	10,178	10,138	10,496	40	(318)	0.4%	-3.0%
Business (Jet)	32,345	25,638	50,751	59,388	(25,113)	(33,750)	-49.5%	-56.8%
Helicopter	7,004	7,345	7,000	7,000	345	345	4.9%	4.9%
Subtotal GA	165,424	164,834	191,341	200,402	(26,507)	(35,568)	-13.9%	-17.7%
Military	904	745	900	1,028	(155)	(283)	-17.2%	-27.5%
Commercial Scheduled Airline								
Passenger	3,627	635	5,949	11,085	(5,314)	(10,450)	-89.3%	-94.3%
Cargo	-	-	-	1,128	-	(1,128)	-	-100.0%
Subtotal Commercial Airline	3,627	635	5,949	12,213	(5,314)	(11,578)	-89.3%	-94.8%
Total Operations	169,955	166,214	198,190	213,644	(31,976)	(47,430)	-16.1%	-22.2%
Based Aircraft	387	340	384	400	(44)	(60)	-11.5%	-15.0%
Commercial Airline Passengers	17,457	8,609	82,238	325,012	(73,629)	(316,403)	-89.5%	-97.4%

Note: 2012 projections from the 2005 *ESPR* are interpolated based on the 2010 and 2020 forecast years. Operations are for the period 7:00 am to 11:00 pm.

Source: Massport and FAA Tower Counts.

The 2005 *ESPR* forecasts also projected 5,900 to 11,100 commercial airline operations and 82,000 to 325,000 passengers in 2012. Actual commercial airline activity fell significantly short of the projections at 635 operations and 8,600 passengers in 2012. The commercial airline industry was also greatly affected by the combination of high fuel prices and weak demand. The airline industry, which has seen fuel prices more than triple since 2000, has consolidated and airlines have radically altered their business models by cutting capacity and withdrawing services from small, secondary regional airports. In the New England region, the secondary Boston area airports, T.F. Green/Providence and Manchester-Boston Regional, experienced passenger declines of 36 and 43 percent, respectively, between 2005 and 2012.

While several segments underperformed relative to the forecasts, training operations were higher than the predicted levels in both the Moderate and the High scenarios. The 2005 *ESPR* forecast predicted 52,300 to 64,200 training operations compared to 70,200 actual operations in 2012.

3.3 Long-term Activity Trends

3.3.1 Total aircraft operations

Hanscom's total aircraft operations, as shown in Table 3-3, have declined at an average annual rate of 2.0 percent from 212,400 in 2000 to 166,200 in 2012. Over the period shown, aircraft operations reached a high of 218,200 in 2003 before falling to a low of 150,000 in 2009, when the economy was at its weakest. All major activity segments (i.e. general aviation, commercial airline and military) experienced declines in activity from 2000 to 2012.

Table 3-3 Summary of Hanscom Field Aircraft Operations, 2000 to 2012

Year	General Aviation	Commercial Airline	Military	Total	Annual Percent Change
2000	204,512	6,572	1,287	212,371	-
2001	197,770	6,414	1,252	205,436	-3.3%
2002	210,221	6,603	1,424	218,248	6.2%
2003	190,789	2,956	1,142	194,887	-10.7%
2004	175,301	4,308	1,195	180,804	-7.2%
2005	165,424	3,627	904	169,955	-6.0%
2006	167,808	3,057	1,592	172,457	1.5%
2007	160,992	3,477	1,438	165,907	-3.8%
2008	164,195	104	1,590	165,889	0.0%
2009	148,604	-	1,307	149,911	-9.6%
2010	161,942	-	1,795	163,737	9.2%
2011	160,830	750	1,419	162,999	-0.5%
2012	164,834	635	745	166,214	2.0%
Average Annual Growth					
2000-2005	-4.2%	-11.2%	-6.8%	-4.4%	
2005-2012	-0.1%	-22.0%	-2.7%	-0.3%	
2000-2012	-1.8%	-17.7%	-4.5%	-2.0%	

Source: Massport and FAA Tower Counts.

3.3.2 General aviation aircraft operations

General aviation (GA) includes all aviation operations except for scheduled commercial airline and military operations. GA includes flying by businesses that provide on-demand passenger or cargo charter services; corporate flight departments; owner-flown aircraft; air ambulance providers; law enforcement, firefighting and public safety agencies; companies that provide aerial services such as photography; and flight schools that train pilots. The GA fleet includes a diverse range of aircraft types from light sport aircraft to sophisticated, long-range business jets, but the predominant general aviation aircraft is the single-engine piston.

Since 2000, GA operations at Hanscom Field have declined from more than 204,000 to 166,200 in 2012. The overall decline at Hanscom mirrors a long-term decline in GA nationally. As shown in Figure 3-2, GA operations at Hanscom fell by 1.8 percent annually from 2000 to 2012 compared to a national decline of 3.5 percent per year. Since the recent recession, GA activity has continued to decline nationwide, falling by 6.7 percent from 2009 to 2012. In contrast, GA activity at Hanscom has returned to growth, increasing by 10.9 percent over the same period. The recovery observed at Hanscom reflects a different mix of GA activities compared to the overall U.S. industry. Business jets, the growth segment of the GA industry, accounts for approximately 5 percent of national GA activity compared to 15 percent GA operations at Hanscom. Hanscom's growth trends in each of the major general aviation segments are summarized in Table 3-4 and described in the following sections.

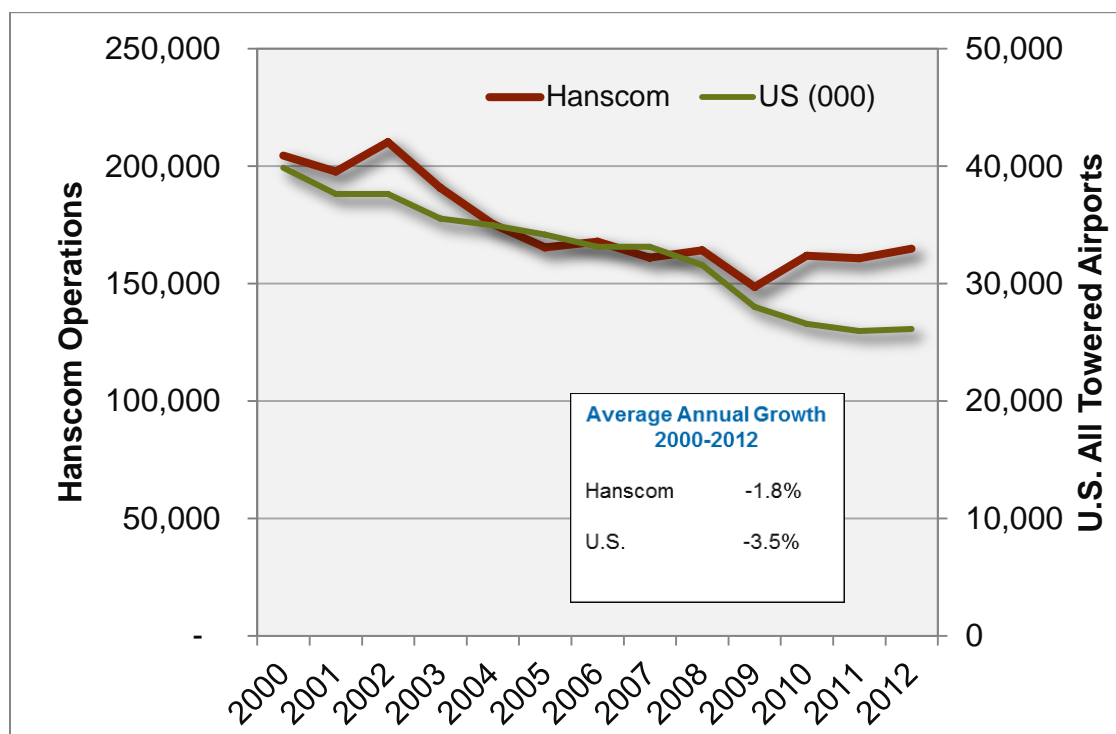


Figure 3-2 Historic Trend in General Aviation Operations at Hanscom Field and U.S. Towered Airports

Note: Includes local and itinerant operations. U.S. operations include operations at towered airports only.

Source: Massport and FAA, Aerospace Forecasts, various years.

Table 3-4 Hanscom Field General Aviation Aircraft Operations, 2000 to 2012

Year	General Aviation Operations							
	Training (SEP)	Personal Flying (SEP)	Business				Helicopter	Total GA
			MEP	Turbo	Jet	Subtotal		
2000	75,676	90,323	5,099	6,274	20,226	31,599	6,914	204,512
2001	72,605	84,803	4,858	7,166	22,839	34,863	5,499	197,770
2002	76,849	82,282	5,295	7,995	30,788	44,078	7,012	210,221
2003	71,696	70,912	4,750	6,101	30,352	41,203	6,978	190,789
2004	60,794	63,713	4,818	5,849	33,061	43,728	7,066	175,301
2005	58,535	57,898	4,265	5,381	32,341	41,987	7,004	165,424
2006	59,222	58,198	4,352	5,771	33,251	43,374	7,014	167,808
2007	56,731	51,776	4,196	6,878	34,522	45,596	6,889	160,992
2008	65,906	50,069	3,977	6,778	30,661	41,416	6,804	164,195
2009	60,263	46,478	3,963	5,588	25,482	35,033	6,830	148,604
2010	66,038	52,631	3,451	5,704	27,293	36,448	6,825	161,942
2011	60,268	56,059	3,542	6,136	27,838	37,516	6,987	160,830
2012	70,196	51,477	3,763	6,415	25,638	35,816	7,345	164,834
Average Annual Growth								
2000-2005	-5.0%	-8.5%	-3.5%	-3.0%	9.8%		0.3%	-4.2%
2005-2012	2.6%	-1.7%	-1.8%	2.5%	-3.3%		0.7%	-0.1%
2000-2012	-0.6%	-4.6%	-2.5%	0.2%	2.0%		0.5%	-1.8%

Source: Massport and FAA Tower Counts.

3.3.2.1 Training operations

The flight schools located at Hanscom Field provide flight instruction to student pilots and advanced skills training to existing pilots. Student pilots accompanied by a flight instructor often practice take-offs

and landings at Hanscom Field. These activities are called “touch-and-go” operations and are typically conducted in single-engine piston aircraft. A touch-and-go operation occurs when an aircraft lands and then takes-off without stopping or exiting the runway.

In 2012, there were 70,200 training (i.e. local) operations at Hanscom Field, an increase of 16.5 percent over the prior year. Although training operations have fluctuated from year to year, the long-term trend has been a decline in training operations at Hanscom. Nationally, local operations at towered airports have decreased at a rate of 3.1 percent per year from 2000 to 2012⁸. However, training operations at Hanscom have declined less sharply, falling at a rate of 0.6 percent per year over the same period.

3.3.2.2 Personal flying operations

Personal, or recreational, operations at Hanscom are conducted with small, single-engine piston aircraft that are often pilot owned. These flights may be for personal travel to leisure or business destinations or for the pleasure of flying.

There were nearly 51,500 personal flying operations conducted at Hanscom in 2012, a decrease of 8.2 percent over the prior year. This has been one of the fastest declining segments of activity at Hanscom Field. From 2000 to 2012, personal flying operations have fallen at an average annual rate of 4.6 percent. This segment of GA flying has also declined nationally but at a more moderate rate. According to the FAA, flying hours in single-engine piston aircraft have fallen by 0.8 percent per year over the same time period.⁹ Personal flying is a price sensitive segment of the general aviation market and is negatively affected by the rising costs of aircraft ownership and fuel prices, as well a weak economic climate. The long-term decline seen in this segment also reflects changing demographics and a declining pool of private pilots. The number of private pilots in the U.S. has declined by 2.4 percent per year from 2000 to 2012.

3.3.2.3 Business/corporate aviation operations

Business operations may be conducted in a variety of aircraft including multi-engine pistons, turboprops and jet aircraft. These operations may involve aircraft owned by corporations, individuals or fractional owners, or aircraft that is leased or chartered through an air-taxi or aircraft charter provider. Companies and organizations of all sizes derive benefits from the flexibility that business aviation provides including: (1) the ability to reach destinations on a more convenient timetable than commercial airline schedules, often eliminating the need for long layover flights; (2) the ability to access multiple locations in a single day; (3) access to locations not easily reached with commercial airline services; (4) eliminates the time spent on airport check-in and security allowing employees from top executive to mid-level manager to be more productive and (4) allows small to large businesses to be more responsive to customer needs.

At Hanscom Field, there were approximately 35,816 business aviation operations in multi-engine piston, turboprop and jet aircraft. Business activity has been the fastest growing segment of operations at Hanscom, increasing at a long-term average rate of 1.0 percent per year from 2000 to 2012. Growth was significantly faster in early part of the period, with operations climbing from less than 32,000 in 2000 to a peak of 45,600. This rapid growth was largely driven by increased interest in private business transportation sparked by growth in fractional ownership programs, increased security screening at commercial airports which made commercial short-haul flights unattractive, and the introduction of new

⁸ FAA, Aerospace Forecasts – FY 2013-2033, March 2013.

⁹ Ibid.

business aircraft models. However, business aviation dropped off sharply following the economic and financial collapse in 2008/09. At Hanscom, business operations fell by 23 percent over the two-year period from 2007 to 2009. Business operations have not yet recovered at Hanscom, as businesses continue to proceed cautiously in an uncertain economic environment.

The long-term increase in business operations at Hanscom has been driven by growth in jet operations, which have grown at a rate of 2.0 percent per year. In comparison, the turboprop segment increased only slightly at 0.2 percent annually and multi-engine piston operations actually declined by 2.5 percent per year due to an aging fleet. In 2012 jets accounted for 72 percent of the business aviation operations at Hanscom.

3.3.2.4 Helicopter operations

Helicopter activity at Hanscom Field has been fairly stable over the historic period at approximately 7,000 annual operations. Over the long-term historical period (2000-2012) helicopter operations have increased slightly at an average rate of 0.5 percent per year.

3.3.3 Military operations

Hanscom AFB is central to the Air Force's development and acquisition of command and control systems. It serves as part of the Air Force Life Cycle Management Center (LCMC), which is responsible for the total life cycle management of Air Force weapon systems. The host unit at Hanscom AFB is the 66th Air Base Group, which supports military personnel and civilians at Hanscom AFB and retired military personnel and dependents in the New England and New York state region. In 2011, some Air Force research labs located at Hanscom were moved to Wright-Patterson AFB, Ohio, and Kirtland Air Force Base, N.M. The former Electronic Systems Center at Hanscom was deactivated in 2012 as part of a major Air Force realignment and was consolidated into the new (LCMC), headquartered at Wright-Patterson AFB resulting in a reduction of personnel at the AFB. Despite the realignment, Hanscom AFB remains an integral part of the evolving electronics technology community in the Boston area, consisting of educational institutions, private industry and military research and development installations. Today, the base continues its leadership role in the development and acquisition of Air Force command and control systems.¹⁰

Since the core functions of the Hanscom AFB do not involve a flying mission, the military operations at Hanscom Field are infrequent and most often involve the transport of military and civilian personnel in business aviation type aircraft. In 2012, there were 745 military operations at Hanscom which represents less than one-half percent of the airport's total aircraft operations. As a result of the Air Force realignment and downsizing at Hanscom, military operations fell by 48 percent in 2012. Over the long-term, military operations at Hanscom have declined at an average annual rate of 4.5 percent (see Table 3-3).

3.3.4 Based aircraft

In 2012, there were 340 aircraft based at Hanscom Field. Approximately 64 percent of the aircraft housed at Hanscom are single-engine pistons. Jets are the next most prevalent type accounting for 23.2 percent of based aircraft. The distribution of based aircraft by type is provided in Figure 3-3.

¹⁰ The Official Web Site of Hanscom Air Force Base

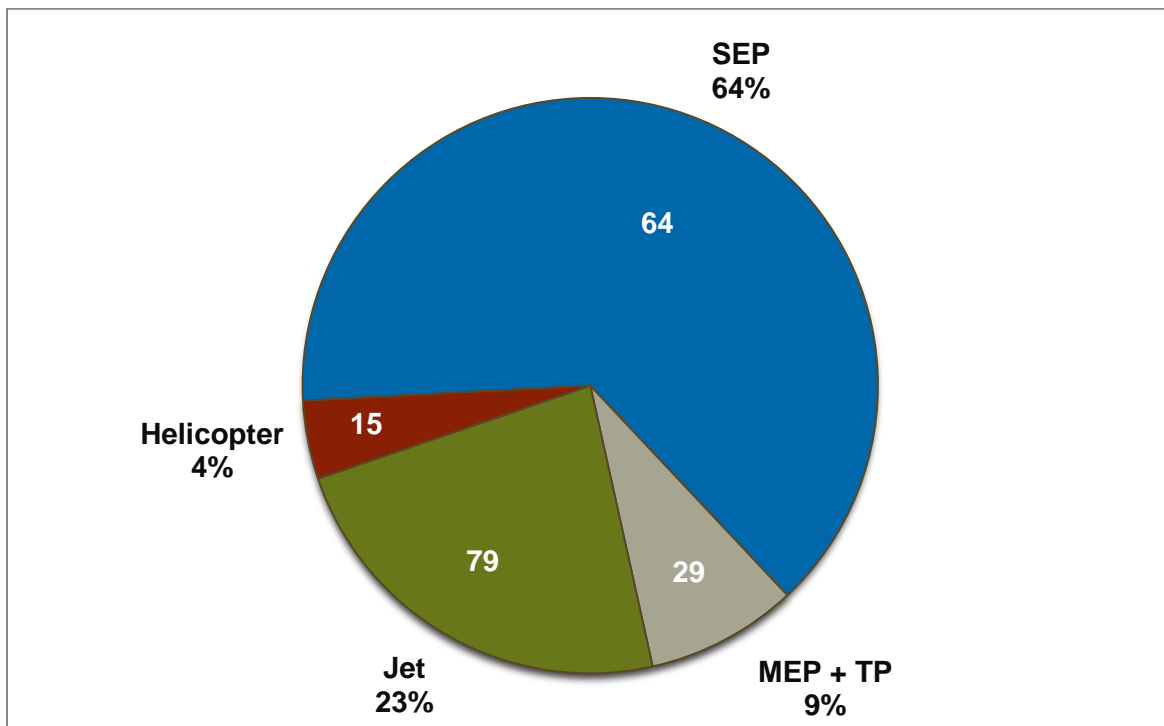


Figure 3-3 Hanscom Field Based Aircraft by Type, 2012

Source: Massport.

The number of aircraft based at Hanscom fluctuates from year-to-year as shown in Figure 3-4. Over the historical period (2000 to 2012), based aircraft reached a high of 411 in 2006 and a low of 290 in 2010. Over the long term, total based aircraft have declined by 14 percent.

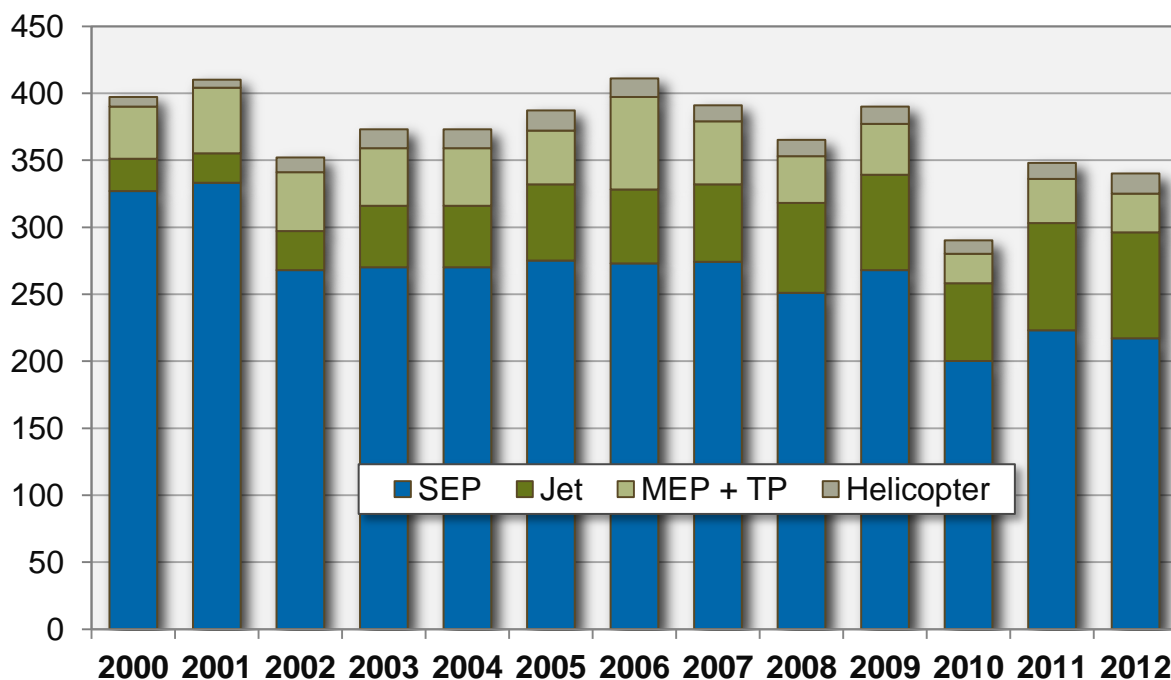


Figure 3-4 Hanscom Field Based Aircraft by Type, 2000-2012

Source: Massport.

The SEP and MEP/TP categories have been in decline, falling by 34 and 26 percent, respectively. While jets based at the airport have more than tripled and helicopters have more than doubled, they accounted for less than 30 percent of Hanscom's based aircraft, combined, in 2012.

3.3.5 Commercial airline activity

Hanscom Field has periodically received limited regional commuter airline services. In the 1980s, services were provided by small regional commuter airlines that linked Hanscom to markets in the Northeast, largely other small airport markets in upstate New York. Traffic in years when services were provided varied from 200 to just under 10,000 passengers. Throughout most of the 1990s there were no scheduled commercial airline services at Hanscom Field.

Table 3-5 summarizes scheduled commercial airline services and passenger traffic at Hanscom Field since 2000. Shuttle America, which entered the Hanscom market in 1999, provided nonstop services to various Northeast markets with small turboprop aircraft. Shuttle America's passenger traffic at Hanscom peaked at 162,000 in 2000. The airline entered bankruptcy in 2002 and eventually became a US Airways feeder carrier, operating under the US Airways Express brand at Hanscom. Shuttle America's Hanscom services were eventually discontinued in 2004 so that aircraft could be redeployed to US Airways' Pittsburgh hub.

Table 3-5 Scheduled Commercial Airline Services and Passengers at Hanscom Field, 2000 to 2012

Year	Airline	Destinations	Total Passengers
2000	Shuttle America	Buffalo, Greensboro, New York La Guardia, Trenton, Wilmington	162,147
2001	Shuttle America	Buffalo, New York La Guardia, Philadelphia, Trenton	134,337
2002	Shuttle America	Philadelphia, Trenton	67,513
	Boston-Maine Airways	Newark, Portsmouth	175
	Total		67,688
2003	Shuttle America	Trenton	36,073
	Boston-Maine Airways	Manchester, Nantucket	26
	Total		36,099
2004	Shuttle America	Trenton	9,972
	Boston-Maine Airways	Portsmouth, Trenton	12,106
	Total		22,078
2005	Boston-Maine Airways	Portsmouth, Trenton	17,457
2006	Boston-Maine Airways	Portsmouth, Trenton	17,680
2007	Boston-Maine Airways	Elmira, Portsmouth, Trenton	17,398
2008	Boston-Maine Airways	Trenton	325
2009	None		0
2010	None		0
2011	Streamline Air	Trenton	6,519
2012	Streamline Air	Trenton	8,609
Note: Includes scheduled commercial passenger airline services operating under FAA Part 121 certificates and public charters operated by air taxi operators governed by FAA Part 135 regulations. Excludes private charters conducted by FAA Part 135 operators.			

Source: Massport and Official Airline Guide

Boston-Maine Airways, headquartered in Portsmouth, NH, operated scheduled commuter services at Hanscom from 2002 to 2008. Trenton was the airline's primary market from Hanscom and services were provided with 19-seat Jetstream 31 turboprop aircraft. The airline's traffic at Hanscom peaked at approximately 17,700 passengers in 2006. Services ended abruptly in February 2008 when the U.S. DOT revoked the airline's operating certificate.

From February 2008 through March 2011, there were no scheduled airline services operating at Hanscom Field. In April 2011, Streamline Air commenced scheduled public charter services from Hanscom Field to Trenton-Mercer Airport in New Jersey. Streamline operated two daily flights on weekdays only with 30-seat Embraer 120 turboprops targeting business passengers. After nearly 18-months of operation, the services were discontinued in September 2012. More than 8,600 passengers flew on the Streamline services in 2012. Since September 2012, there have been no scheduled passenger airline services operating at Hanscom Field.

Table 3-6 summarizes scheduled passenger airline activity at Hanscom Field from 2000 to 2012. Passenger traffic peaked at 162,000 at the beginning of the period. Aircraft operations peaked at approximately 6,600 in 2000 and 2003. The average passengers per flight varied from nearly 25, when Shuttle America served the market with 50-seat turboprops to a low of 3-5 when Boston-Maine Airways operated 19-seat turboprops at Hanscom.

Table 3-6 Scheduled Commercial Passenger Airline Activity at Hanscom Field, 2000 to 2012

Year	Passengers	Aircraft Operations	Passengers per Operation
2000	162,147	6,572	24.7
2001	134,337	6,414	20.9
2002	67,688	6,603	10.3
2003	36,099	2,956	12.2
2004	18,123	4,308	4.2
2005	17,457	3,627	4.8
2006	17,680	3,057	5.8
2007	17,398	3,477	5.0
2008	325	104	3.1
2009	-	-	-
2010	-	-	-
2011	6,519	750	8.7
2012	8,609	635	13.6

Source: Massport

3.3.6 Nighttime activity

The nighttime period at Hanscom Field is defined as 11:00 pm to 7:00 am, the period when the FAA Tower is closed and when Massport's nighttime field use fee is in effect. In 2012, there were 1,631 nighttime operations, representing approximately one percent of Hanscom's total aircraft operations (see Table 3-7). The majority of nighttime operations are conducted by jet aircraft, which accounted for 72 percent of the nighttime activity in 2012.

Total nighttime operations have fluctuated from year-to-year as overall activity has fluctuated. From 2000 to 2012, nighttime operations decreased by 15 percent while total aircraft operations (including nighttime activity) fell by 22 percent. There has been reduced nighttime activity in all but one aircraft category. Jet operations during the nighttime have grown by 24 percent over the long-term historical period, consistent with the overall growth of jet operations at the airport (+27 percent).

Table 3-7 Nighttime Operations (11:00 pm to 7:00 am) at Hanscom Field, 2000 to 2012

Year	Jet	MEP + TP	SEP	Helicopter	Military	Total
2000	944	353	194	427	n/a	1,918
2001	808	273	161	432	n/a	1,674
2002	1,079	377	142	572	n/a	2,170
2003	1,035	153	130	425	n/a	1,743
2004	1,100	164	136	606	n/a	2,006
2005	1,131	131	112	520	n/a	1,894
2006	1,148	148	298	730	n/a	2,324
2007	1,350	211	175	547	n/a	2,283
2008	1,244	148	81	437	n/a	1,910
2009	1,075	136	106	418	n/a	1,735
2010	1,199	174	74	385	n/a	1,832
2011	1,230	179	143	276	n/a	1,828
2012	1,173	251	63	141	3	1,631
Percent Change (2000-2012)	24.3%	-28.9%	-67.5%	-67.0%	n/a	-15.0%

1 The nighttime operations presented in the 2012 ESPR differ slightly from those published in the Hanscom Field Annual Noise Report. This discrepancy is due to the difference in the timing of the preparation for the two reports. Each report used the best available data at the time of the analysis for that report. The difference of approximately 0.3 daily nighttime operations or 0.07% of all daily operations would change computed noise levels by less than 0.1 dB, which is imperceptible and would not change the analysis presented.

Source: Massport

3.4 Aviation Activity Forecasts

The forecasts of aviation activity at Hanscom Field include projections of aircraft operations, scheduled airline passengers and based aircraft for near-term (2020) and long-term (2030) planning periods. The forecasts assume that Hanscom Field continues to function as a general aviation reliever for Logan Airport and the premier business aviation airport in the Greater Boston area with limited military and commercial airline operations.

The GA forecasts are based on historical trends at Hanscom, national historical trends and industry projections for general aviation, the economy and fuel prices. The forecast of commercial airline activity is based on a scenario of the potential types of services that Hanscom could accommodate given current and projected trends in the overall airline industry. All forecast assumptions are consistent with Massport's 1980 regulations limiting scheduled commercial passenger services to aircraft with 60 or fewer seats. Forecasts for each of the distinct segments of aviation activity are described in the following sections.

3.4.1 General aviation aircraft operations

GA activity at Hanscom Field is forecast to increase from approximately 164,800 operations in the base year to 190,600 operations in 2030. Separate forecasts were developed for each of the sub-segments of GA activity: 1) pilot training; 2) personal flying; 3) business/corporate flying and 4) helicopter operations. Forecasts for each of these sub segments is summarized in Table 3-8 and described in the following sections.

Table 3-8 Forecast Hanscom Field General Aviation Aircraft Operations, 2020 and 2030

	Actual		Forecast		Average Annual Growth		
	2005	2012	2020	2030	2012 - 2020	2020 - 2030	2012 - 2030
Training (SEP)	58,535	70,196	62,605	65,164	-1.4%	0.4%	-0.4%
Personal Flying (SEP)	57,894	51,477	50,661	58,285	-0.2%	1.4%	0.7%
Business Non-Jet (MEP)	4,265	3,763	3,837	4,321	0.2%	1.2%	0.8%
Business Non-Jet (Turbo)	5,381	6,415	7,024	8,664	1.1%	2.1%	1.7%
Business (Jet)	32,345	25,638	35,043	46,782	4.0%	2.9%	3.4%
Helicopter	<u>7,004</u>	<u>7,345</u>	<u>7,345</u>	<u>7,345</u>	<u>0.0%</u>	<u>0.0%</u>	<u>0.0%</u>
Total General Aviation	165,424	164,834	166,515	190,561	0.1%	1.4%	0.8%

Source: Massport

3.4.1.1 Training operations

Pilot training operations, or local SEP operations, are forecast to decline over the forecast period from 70,200 operations in 2012 to 65,164 operations in 2030. The forecast rate of decline is 0.4 percent per year and is similar to the rate of decline over the historical period, 0.6 percent from 2000 to 2010. Projected trends that will influence pilot training activity include a decline in student pilots. Nationally, the FAA forecasts the student pilot base to decline by 0.1 percent per year through 2030.¹¹

3.4.1.2 Personal flying operations

The level of personal flying operations, or itinerant operations in single-engine piston aircraft, is sensitive to the state of the economy and the costs of private flying, especially fuel prices. Over the forecast period, economic growth is expected to be moderate and fuel prices are projected to increase further. In its national projections, the FAA assumes that U.S. Gross Domestic Product, adjusted for inflation, increases at an average annual rate of 2.5 percent through 2030. The FAA also assumes that the cost of fuel, as measured by the cost of crude oil, continues to increase over the long term, rising at an average rate of 0.9 percent per year.¹²

At Hanscom Field, personal flying operations are forecast to increase from nearly 51,500 in 2012 to approximately 58,300 in 2030. Activity is forecast to grow at a slower pace than the economy, increasing by 0.7 percent per year over the planning horizon.

3.4.1.3 Business/corporate aviation operations

The long-term outlook for business aviation remains strong, though not as optimistic as projections from the mid-2000s. The FAA assumes that nationally business aviation will continue to recover from the 2008/09 economic downturn as the economy improves and corporate profits rise. Over the long term, business aviation is expected to be an attractive option over commercial aviation due to the increased flexibility that it provides and continued concerns over safety, security and commercial airline flight delays. The FAA forecasts total flight hours in turboprop and jet aircraft in the U.S. to grow by 2.1 and 4.3 percent, respectively, through 2030.

Business aviation at Hanscom Field is forecast to be consistent with the national outlook and is predicted to increase by 2.9 percent per year. Total business aviation operations are forecast to reach 59,800 in 2030, up from 35,800 in 2012. Jet operations are forecast to continue to grow the fastest and are

¹¹ FAA, Aerospace Forecasts – FY 2013-2033, March 2013.

¹² Ibid.

predicted to increase by 3.4 percent per year to nearly 46,800 in 2030. Non-jet operations are forecast to grow at a slower pace of 1.4 percent growing to nearly 13,000 operations by 2030.

3.4.1.4 Helicopter operations

Helicopter activity at Hanscom has remained relatively stable over the historical period at around 7,000 annual operations. Consistent with the historic trend, helicopter operations are forecast to remain constant at the 2012 level (7,345 annual operations).

3.4.2 Based aircraft

Aircraft based at Hanscom Field are forecast to increase over the planning period from 340 aircraft in the base year to 416 aircraft in 2030. Business jet aircraft based at the airfield are projected to grow from 79 in 2012 to 120 in 2030. Similar to past trends, jets will account for an increasing share of based aircraft at Hanscom Field. Jets represented 6 percent of based aircraft in 2000 and 23 percent of based aircraft in 2010. Over the forecast period, the jet share of based aircraft is projected to rise further to 29 percent. At more than 240 based aircraft, single-engine pistons will continue to be the predominant aircraft type housed at Hanscom. However, the single-engine piston share will drop from 64 percent in 2012 to 58 percent in 2030. Forecasts of based aircraft were developed based on historical ratios of operations per based aircraft for each aircraft category.

3.4.3 Military operations

Since the military's function at Hanscom AFB does not involve an active flying mission, annual military operations are less than one percent of the total aircraft operations at the airfield. The forecast assumes that the air force base remains active over the forecast period and continues to focus on research, development and management functions. Consistent with this assumptions, future military operations are projected to hold constant at the 2012 level (745 operations).

3.4.4 Commercial airline activity

There have been no scheduled commercial airline passenger services at Hanscom Field since Streamline Air discontinued its services in September 2012. Therefore, the forecast of commercial airline services is based on a scenario of the type of services and the type of airline that may initiate operations at Hanscom and is not a continuation of past trends. The commercial airline scenario for Hanscom considers the current and projected operating environment for U.S. air carriers. Faced with sustained, high fuel prices, the airline industry has consolidated and U.S. airlines have drastically altered their business models. Through consolidation and restructuring, airlines have shed many unprofitable routes and have withdrawn from or scaled back services at many smaller, secondary markets. Since 2007, airlines have reduced scheduled weekly departures from non-hub airports by 19 percent and more than three dozen non-hub airports have lost all commercial services.¹³ Airlines have also renewed their aircraft fleets eliminating fuel inefficient and uneconomical models including regional jets with 50 or fewer seats.

The commercial airline forecast scenario assumes that the types of service that may be implemented at Hanscom would be similar to the service most recently provided. This includes a small regional airline or public charter provider operating small turboprop or regional jet aircraft to short haul business markets.

¹³ Based on scheduled weekly departures at non-hub airports in the continental U.S. as reported in the Official Airline Guides for August (2007 to 2013).

The forecast services would comply with Massport's 1980 Regulations for Hanscom Field, which prohibit scheduled commercial passenger services in aircraft with more than 60 seats. The Hanscom forecast specifically assumes weekday service operated with a 30-seat turboprop aircraft (Embraer Brasilia) serving one to two destinations in the Northeast. The forecast scenario details are summarized in Table 3-9.

Table 3-9 Summary of Forecast Commercial Passenger Service Assumptions, 2020 and 2030

Aircraft Type:	Small turboprop with 30 seats, e.g., Embraer 120
Number of Nonstop Markets:	One in 2020 Two in 2030
Types of Markets:	Business destinations in the northeast, e.g., Trenton
Service Frequency:	Two roundtrips per market, five days a week
Average Load Factor:	65%

Source: Massport

As shown in Table 3-10, Hanscom Field is projected to accommodate 20,300 commercial airline passengers by 2020 and 40,600 in 2030. With weekday only services provided to one destination in 2020, annual commercial airline operations are forecast at 1,040. In 2030, under the assumption of weekday services to two destinations, annual operations increase to 2,080. Since the scenario assumes that services would be targeted to the business traveler, the 2030 forecast assumes that one daily departure would occur in the early morning before 7:00 am. Thus, in the 2030 forecast, there are 1,820 commercial airline operations that would occur between 7:00 am and 11:00 pm, and 260 commercial airline flights that would be operated during the 11:00 pm to 7:00 am period.

Table 3-10 Forecast Commercial Passenger Airline Activity at Hanscom Field, 2020 and 2030

	Actual		Forecast	
	2005	2012	2020	2030
Aircraft Operations	3,627	635	1,040	2,080
Passengers	17,457	8,609	20,280	40,560
Passengers per Operation	4.8	13.6	19.5	19.5

Source: Massport

3.4.4.1 Procedures for new-entrant airlines

An airline proposing to commence scheduled service at Hanscom Field must comply with established FAA and Massport requirements for new entrant airlines. At the federal level, a new entrant to Hanscom must have its Operations Specifications ("OpSpecs") amended by the FAA to permit services to Hanscom Field with a specified type of aircraft. OpSpecs must be amended each time an airline adds a new destination from any airport or uses a new type of aircraft at an airport. Once an amendment is granted for a specific market and aircraft type, additional amendments or approvals are not needed to increase the frequency of service.

New commercial service at Hanscom Field proposed by new airline entrants must be consistent with the Master Plan and 1980 Massport Regulations. The Master Plan provides that the economic, noise and ground access impacts of new passenger or air cargo service proposals will be reviewed with the

Hanscom Field Advisory Commission. Massport Regulations prohibit commercial passenger services at Hanscom with aircraft that have more than 60 seats.

As a prerequisite to entering into an operating agreement with Massport, an airline must submit to Massport all valid and current certifications, authorizations, and approvals from all state, federal and other governmental bodies applicable to the proposed aircraft type and operations. Specifically, an airline must submit its FAA-approved OpSpecs authorizing the proposed service at Hanscom Field, in accordance with applicable provisions of federal law. Thus, no new carrier may begin service until all necessary approvals have been secured.

3.4.5 Nighttime activity

Total nighttime aircraft operations (11:00 pm to 7:00 am), including general aviation, commercial airline and military activity, are forecast to increase from 1,631 in the base year to 2,766 in 2030. Forecasts of nighttime operations for GA activity are based on the forecasts of annual activity by market segment described above and the historical share of annual activity that occurs in the nighttime period. As shown in Table 3-11, approximately 4 percent of jet aircraft operations and 2 percent of general aviation turboprop operations occur during the nighttime hours. Less than one percent of itinerant operations in single-engine or multi-engine piston aircraft occur during the nighttime period. In addition to nighttime operations by GA users, the forecast assumes that a commercial airline serving business destinations may operate an early morning (e.g., 6:00 am to 7:00 am) departure.

In 2030, jet aircraft are forecast to account for approximately 2,000 nighttime operations representing more than 70 percent of total predicted nighttime activity. Turboprop aircraft are forecast to account for approximately 600 nighttime operations in 2030. These include approximately 340 operations by GA users and 260 operations by a commercial passenger airline. The forecast includes less than 300 nighttime operations by piston aircraft (SEP and MEP) and nighttime activity by helicopter and military aircraft is projected to hold constant at the 2012 levels.

Table 3-11 Forecast Nighttime Operations (11:00 pm to 7:00 am) at Hanscom Field

Year	General Aviation				Military	Commercial Airline	Total
	Jet	MEP + TP	SEP	Helicopter			
Actual							
2005	1,131	131	112	520	n/a	0	1,894
2012	1,173	251	63	141	3	0	1,631
Forecast							
2020	1,515	192	92	141	3	0	1,944
2030	2,023	233	106	141	3	260	2,766

¹ The nighttime operations presented in the 2012 ESPR differ slightly from those published in the Hanscom Field Annual Noise Report. This discrepancy is due to the difference in the timing of the preparation for the two reports. Each report used the best available data at the time of the analysis for that report. The difference of approximately 0.3 daily nighttime operations or 0.07% of all daily operations would change computed noise levels by less than 0.1 dB, which is imperceptible and would not change the analysis presented.

Source: Massport

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4 Airport Planning

Planning is critical to putting an airport in a position to address fundamental needs to meet future operating conditions and respond to new opportunities in a cost-effective and environmentally sensitive way. The Environmental Status and Planning Report (ESPR) plays an important role in Massport's planning process and addresses potential future activities in the context of environmental review and stakeholder engagement. This chapter is focused on the development planning framework for Laurence G. Hanscom Field (Hanscom) and how it aligns with local and regional planning activities. In this context, Massport presents potential physical and operational conditions consistent with the 2020 and 2030 activity forecast scenarios described in Chapter 3, Airport Activity Levels, and baseline conditions and needs described in Chapter 2, Facilities and Infrastructure.

Massport's primary responsibility at Hanscom Field is to maintain a safe, secure, and efficient regional airport while minimizing the environmental impact of its operations. It maintains Hanscom as a first-class, full-service airport. Massport consistently couples improvements and maintenance at the airport with a variety of environmental initiatives, programs, and policies.

Forecasts and planning assumptions presented in this ESPR are founded on the 1978 Hanscom Field Master Plan and Environmental Impact Statement (Master Plan) and Massport's 1980 regulations, which establish the general planning framework for Hanscom Field. For context, this chapter describes the key aspects of the 1978 Master Plan and Massport's 1980 regulations as well as other planning criteria, such as Executive Orders 385 and 438 that affect airport planning statewide, regional planning studies such as those conducted by the Metropolitan Area Planning Council (MAPC) and local planning from the host municipalities. The forecasts are projections of what could occur (not what will occur) in the future using certain planning assumptions and are not necessarily recommended outcomes. This ESPR also evaluates current Massport planning initiatives, projects and the 2020 and 2030 planning concepts for their consistency with local and regional planning.

4.1 Key Findings Since 2005

The 2005 *ESPR* evaluated potential master planning development scenarios in the years 2010 and 2020 using several different growth forecasts. Given the downturn in the national economy that resulted in an overall contraction in aviation growth, only a small amount of construction occurred. The following is a list of projects, which have been completed:

- Runway Safety Area (RSA) improvements at Runway Ends 5 and 23 including grading of the RSA and wetland replication
- RSA improvements on Runway 11 by relocating portions of the perimeter road
- Reconstruction of the western end of Taxiway E, Taxiway G, and Taxiway M
- Redevelopment of the Hangar 24 site for a Fixed Base Operator (FBO) facility by Rectrix Aviation, a project which is nearing completion at this time
- Removal of fuel storage tanks at Hangar 10

- Implementation of enhanced access control system and replacement of a portion of the perimeter fence
- Relocation of portions of the perimeter road at approach to Runway 29
- Ongoing airfield maintenance
- Ongoing vegetation removal and maintenance

Massport spent approximately \$3.4 million on improvements in 2012.

In this *ESPR*, Massport has reassessed the primary planning areas considered in the *2005 ESPR*. It has updated planning to reflect changes in aircraft mix and related infrastructure issues as well as an updated view of aviation growth expectations borne out of the activity level forecasts presented in Chapter 3, Airport Activity Levels.

4.2 Airport Planning Context

Massport has developed the planning concepts evaluated in this *2012 ESPR* within the framework of the 1978 Master Plan and Massport's 1980 Regulations. Jointly, the Master Plan and the Regulations provide the planning framework for Hanscom Field. Massport also considers the following:

- Federal, state, and local environmental regulatory requirements and review processes;
- Executive Order 385, which is the Growth Management Policy for Massachusetts;
- Executive Order 438, which initiated the new State Sustainability Program;
- Regional planning framework;
- Local comprehensive and growth management plans; and
- Long-range plans for the Minute Man National Historical Park (MMNHP) and Hanscom Air Force Base (AFB).

This approach provides a planning context for potential improvements at the airport.

The economic downturn and events of September 11, 2001, has had a significant impact on airport planning in the United States. Hanscom is continually adapting and adjusting to new Massport and Transportation Security Administration (TSA) issued security directives. Furthermore, legislative mandates are affecting airports near- and long-term operations and planning efforts. Hanscom Field will be subject to many of these mandates and will comply as required by law. Examples of security-driven projects might include reconfiguring terminal space or parking facilities, relocating airport functions from non-secure to secure locations, and implementing airfield access restrictions.

Massport acknowledges the importance of managing Hanscom Field in an environmentally sensitive manner that recognizes the significance of MMNHP, Hanscom AFB, and the towns of Bedford, Concord, Lexington, and Lincoln. The following sections describe local and regional planning initiatives, including overviews of the comprehensive plans of the four towns and information gathered through discussions with local officials and the National Park Service (NPS) as part of the process to prepare the *2012 ESPR*.

4.2.1 Airport Land Plans and Regulations

4.2.1.1 Hanscom Field Master Plan and Regulations

In 1978, Massport issued the "Hanscom Field Master Plan and Environmental Impact Statement." In response to community concerns that developed when Massport took over operation of Hanscom Field in 1974, Massport outlined a number of policies in the Master Plan that still guides Massport's management of and planning for Hanscom Field. The adoption of the Massport Regulations and Noise Rule in 1980

was an outgrowth of the Master Plan. The Master Plan and the 1980 Noise Rules limit commercial airline service to passenger aircraft with 60 seats or less and also applies a nighttime field use fee to help discourage activity between 11 p.m. and 7 a.m.

In 1978, the Master Plan foresaw aviation-related development on lands dedicated to aviation-related uses or on U.S. Air Force (USAF) land that would later be ceded to Massport. Other land uses, according to the Master Plan, would be developed in a manner compatible with existing, adjacent land uses and airport operations.

These policies and regulations have guided Massport's development of the *2012 ESPR*, which reaffirms the role of Hanscom Field as a premier regional GA airport

4.2.1.2 Hanscom Airport Layout Plan

The Federal Aviation Administration (FAA) defines the Airport Layout Plan (ALP) as a set of scaled drawings depicting existing and future airport facilities and property. This section provides a description of the eight drawings contained in the Hanscom Field ALP set. Appendix B presents the 2011 ALP for Hanscom Field, which reflects the planning conducted since the FAA approved the previous ALP in 1981.

The 2011 ALP reflects planning improvements discussed in the *2005 ESPR*. The ALP set described here offers a graphic depiction of Hanscom's existing scenario, potential development projects, "imaginary surfaces" that protect the airfield, and the existing land use in and around Hanscom. The ALP set is prepared in compliance with FAA standards.

The ALP indicates areas that might be suitable for future aviation-related or compatible aviation land uses, as well as buildings that might be suitable for future aviation-related facilities. Specifically, areas shown as potential locations for future aviation-related use include the south and southeast of the Civil Air Terminal, East Ramp, North Airfield by the U.S. Navy Hangar, west of Runway 5-23 near Taxiway M, and east of Runway 5-23 near the Parcel B land that the USAF previously managed. The only proposed new taxiway in the ultimate configuration is east of the current Civil Air Terminal. A new parallel taxiway to existing parallel Taxiway S would serve aircraft landing or departing on Runway 5-23.

According to the Existing Land Use sheet in the ALP, the majority of land use at Hanscom is designated Transportation. A small percentage of land within the Runway Protection Zones (RPZs) is designated as Open Land, Wetlands, Agriculture, and Forest.

4.2.1.3 Procedures for New Airline Entrants

Commercial air travel is a small component of Hanscom's future forecasted aviation activity. An airline must follow Massport and FAA procedures to commence scheduled services at Hanscom. The specific process for a new airline entrant is discussed in Chapter 3, Airport Activity Levels, and is incorporated into the airport planning process.

4.2.2 Environmental Planning

Massport has developed the *2012 ESPR* for review under the Massachusetts Environmental Policy Act (MEPA). However, the document is utilized in a broader context. For example, the FAA has used the environmental analyses contained in prior MEPA documents (Generic Environmental Impact Reports [GEIRs] and ESPRs) to assist with its evaluation of potential impacts of proposed actions at Hanscom Field. Depending upon the nature of the proposed action, the FAA could determine that the

documentation of potential impacts discussed in the *2012 ESPR* meet the FAA's responsibilities under the National Environmental Policy Act (NEPA) review. Likewise, the FAA could determine that additional analysis is required and that an Environmental Assessment (EA) or Environmental Impact Statement (EIS) would have to be prepared depending on the nature and anticipated impacts of the proposed action(s).

In addition to the role that the FAA plays in the environmental review process for airport projects, it also requires air service operators to meet specific environmental and operational requirements. Massport requires that carriers obtain all FAA approvals as well as all applicable state and local approvals prior to entering into an operating agreement with Massport. Thus, Massport does not allow any new carrier to begin service until it has secured all necessary environmental approvals.

FAA Orders 1050.1E, Change 1, Environmental Impacts: Policies and Procedures (FAA 2006) and 5050.4B, National Environmental Policy Act (NEPA) Implementing Instructions for Airport Projects (FAA 2006) provide instructions and guidelines for preparing and processing NEPA documents for airport development proposals and other airport actions as required by law. In accordance with FAA regulations, some projects are "categorically excluded" from environmental review due to the low potential for adverse environmental impact (referred to as a CATEX). Examples include acquiring security equipment required by rule or regulation for the safety of security personnel and property on the airport and safety equipment required by rule or regulation for certification of an airport. The specific action being requested will determine the type of environmental processing required by the FAA.

In the event that a project is not categorically excluded from environmental review, the potential environmental consequences associated with a proposed action would be assessed as determined by the FAA. Such environmental review, as specified in FAA Orders 1050.1E (Policies and Procedures for Considering Environmental Impacts, June 8, 2004) and 5050.4B (NEPA, April 28, 2006), includes an analysis of the following impacts:

- Air Quality
- Coastal Resources
- Compatible Land Use
- Construction Impacts
- Department of Transportation Act: Section 4(f)
- Farmlands
- Fish, Wildlife, and Plants
- Floodplains
- Hazardous Materials, Pollution Prevention, and Solid Waste
- Historical, Architectural, Archeological, and Cultural Resources
- Light Emissions and Visual Impacts
- Natural Resources, Energy Supply, and Sustainable Design
- Noise
- Secondary (Induced) Impacts
- Socioeconomic Impacts, Environmental Justice, and Children's Environmental Health and Safety Risks
- Water Quality
- Wetlands
- Wild and Scenic Rivers

Some of these categories, such as impacts to coastal zone management and coastal barriers, would not apply to an action at Hanscom Field.

There is potential that some projects included in this ESPR could require development proximate to wetland areas, particularly those within the Terminal Area and North Airfield. Massport is committed to minimizing environmental impacts and would avoid these impacts to the extent possible, and fully mitigate any unavoidable impacts. None of the projects contemplated would require filling of wetlands. Permits for fill in wetlands would be required from the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act and Massachusetts Department of Environmental Protection under the Massachusetts Wetlands Protection Act. Section 404 of the Clean Water Act requires demonstration of efforts to first avoid wetland impacts, and then minimize wetland impacts, and mitigate any impacts that cannot be avoided or minimized. Wetlands at Hanscom are described in detail in Chapter 9, Wetlands Wildlife and Water Resources.

4.2.3 Municipal Partners

Hanscom Field is located within the towns of Bedford, Concord, Lexington, and Lincoln, which are suburban communities of metropolitan Boston with strong economic ties to the high-tech and service economies that anchor Route 128/I-95. These suburbs are moderate-density residential communities with a lessening amount of developable property. More than half of the housing units are single-family homes that are owner-occupied.¹⁴ As Table 4-1 indicates, the four towns have undergone significant changes since 1970, when Hanscom Field activity peaked at more than 300,000 operations. Between the years of 1970 and 2000, the population of Bedford and Lexington showed a slight decrease, while Concord and Lincoln increased. Overall, the decline in population was under 2 percent. This is compared to a general population increase of all four communities combined of almost two percent from 2005 to 2010.

Table 4-1 Population Trends in Bedford, Concord, Lexington, and Lincoln

Town	1970	2000	Percent Change Between 1970-2000	2000	2005	Percent Change Between 2000-2005	2005	2010	Percent Change Between 2005-2010
Bedford	13,513	12,595	-6.80%	12,595	12,462	-1.10%	12,462	13,320	6.88%
Concord	16,148	16,993	5.20%	16,993	16,833	-0.90%	16,833	17,668	4.96%
Lexington	31,886	30,355	-4.80%	30,355	30,266	-0.30%	30,266	31,394	3.73%
Lincoln	7,567	8,056	6.50%	8,056	7,931	-1.60%	7,931	6,362	-19.78%
TOTAL	69,114	67,999	-1.60%	67,999	67,492	-0.7%	67,492	68,744	1.86%

Source: U.S. Census Data 1970, 2000, 2005, and 2010.

As shown in Table 4-2, the MAPC forecasts for 2020 and 2030 indicate that the populations of the four towns will increase 6.5 percent by 2020 and 8.1 percent by 2030 from 2010. Average household size may decrease from 2.6 to 2.4 people per household, and the region may experience a decline in school-aged children and an increase in the over-55 population.¹⁵

¹⁴ Metropolitan Area Planning Council, *MetroFuture: Regional Plan*, 2008.

¹⁵ Metropolitan Area Planning Council, *MetroFuture: Regional Plan*, 2008.

Table 4-2 Population Projections for Bedford, Concord, Lexington, and Lincoln

Town	2010	2020	2030	Percent Change	
				2010 to 2020	2010 to 2030
Bedford	13,320	13,756	14,077	3.3%	5.68%
Concord	17,668	18,565	19,216	5.1%	8.76%
Lexington	31,394	32,089	31,985	2.2%	1.88%
Lincoln	6,362	8,803	9,031	38.4%	41.95%
TOTAL	68,744	73,213	74,309	6.5%	8.10%
1. 2020 and 2030 reflects MAPC estimates after input from municipalities.					

Source: U.S. Census Data (2010) and MAPC (2020 and 2030)

As shown in Table 4-3, available employment data indicate that the overall number of jobs in the four towns decreased by approximately 6 percent from 56,000 in 2000 to almost 53,000 in 2010. Contributing factors include the effects of September 11, 2001, and the closing of Raytheon's Hartwell Road facility just north of Hanscom Field. Projections suggest that the four towns will see an almost 19 percent increase by 2020 and over a 22 percent increase by 2030. In the Boston region, half of the net new jobs are expected to be in Professional and Business Services and Education and Health Services. Manufacturing jobs are expected to decline, with an estimated reduction of approximately 46,000 jobs, a decrease of 16 percent.¹⁶

With some minor variations, the population and job trends in this region over the last 35 years are consistent with the general growth patterns in the metropolitan area. As Tables 4-2 and 4-3 indicate, future projections by MAPC indicate that population and the employment trends in the four towns will increase over the next 20 years.

The number of jobs and projected population increases in the four towns illustrate the importance of these communities as employment centers. MAPC employment projections in Table 4-3 indicate that future growth is anticipated in each town, with the highest levels expected to occur in Bedford (over 26 percent).

Table 4-3 Employment Trends and Projections for Bedford, Concord, Lexington, and Lincoln

Town	Past Trends				Future Trends			
	2000	2004	2010	Percent Change (2000-2010)	2020	2030	Percent Change	
							2010 to 2020	2010 to 2030
Bedford	19,938	18,653	19,473	-2.33%	22,940	22,705	17.80%	16.60%
Concord	13,425	12,204	11,916	-11.24%	12,685	12,464	6.45%	4.60%
Lexington	21,009	19,622	19,281	-8.23%	22,392	21,548	16.14%	11.76%
Lincoln	1,668	1,718	2,004	20.14%	1,824	1,295	-8.98%	-35.38%
TOTAL	56,040	52,197	52,674	-6.01%	59,841	58,012	13.61%	10.13%
1. 2020 and 2030 reflects MAPC estimates after input from municipalities.								

Source: U.S. Census Data (2000, 2004, 2010) and MAPC (2020 and 2030).

Absent changes in travel behavior and land use development patterns, the estimated increases in population and employment will result in continued growth in traffic demand on area roadways, particularly for suburb-to-suburb trips, entirely unrelated to operations or developments at Hanscom Field. Massport has participated in transportation demand management (TDM) programs, and these measures are described in Chapter 6, Ground Transportation. Other measures include "growth

¹⁶ Metropolitan Area Planning Council, *MetroFuture: Regional Plan*, 2008.

management” initiatives to reduce sprawl by improving land use management practices. Concentrating development at Hanscom Field and the AFB supports smart growth principles and minimizes sprawl in adjoining land areas.

4.2.3.1 Bedford

Bedford produced a comprehensive plan in 2002.¹⁷ The plan includes nine elements: land use, housing, economic development, natural and cultural resources, open space and recreation, services and facilities, circulation and implementation. At this time, Bedford is updating its comprehensive plan to include responses to issues and needs for the next 10 years and beyond, and the following sections will be reflected: land use, economic development, transportation and housing, natural resources and open space; cultural and historic resources; services, facilities and recreation; and aspects of energy.

Massport has worked through the Bedford Conservation Commission to secure environmental approvals for several projects including the Vegetation Management Plan (VMP), the RSA project, and the perimeter service road relocation.

A high priority for Hanscom is to maintain compliance with FAA certification and safety requirements. The intention of the VMP is to identify obstructions for removal in the approach and departure surfaces for all four runway ends. Since the preparation of the *2000 ESPR*, Massport implemented Phase I of the VMP (2004-2008) in accordance with Bedford’s Order of Conditions. Then in 2007, Massport performed an aerial photogrammetric mapping of the approach and departure surfaces for all four runway ends to develop the second VMP. Massport found that:

- the first implementation of the VMP minimized the need for additional vegetation removal in areas cut in 2004.
- vegetation removal was required in areas that were not part of the first 5-year VMP.
- there were obstructions in Bedford’s Jordan Conservation Area (JCA).
- there were no obstructions in the Bedford Hartwell Town Forest.

In 2008, Massport submitted the second VMP to the Conservation Commissions of the four towns, along with Notices of Intent (NOI) for the required vegetation removal in wetland areas. By early 2009, Massport received Orders of Conditions for vegetation removal in wetland areas from all four towns and vegetation removal began mostly on Massport property. Chapter 9, Wetlands Wildlife and Water Resources, includes additional information about the VMP and effects on wetland resources.

Massport also identified for removal seven obsolete light poles that were at the Runway 23 end both on and off Massport property. Of the 10 original light poles, Massport left in place the three furthest from the airport, but it removed all equipment from them. The three remaining light poles are not obstructions to the approach and departure surfaces. In February 2013, all obstructions identified in the 2007 Hanscom Airspace Analysis had been removed.

The *2012 ESPR* did not identify additional potential uses in the West Airfield Area and facilities identified in the *2005 ESPR* are currently not being considered.¹⁸ Massport would consider proposed uses in the West Airfield Area that are compatible with the natural resources found there and that incorporate prudent resource management.

¹⁷ Town of Bedford, Bedford Comprehensive Plan, 2002.

¹⁸ The 1995 GEIR explored non-aviation development in the West Airfield area, including office parks and a golf course.

The 2002 Bedford Comprehensive Plan indicates the importance of alleviating traffic congestion along Great Road. Hanscom-related traffic is considered a minimal contributor to traffic volumes on Bedford roadways comprising approximately 4 percent of morning and afternoon peak traffic. In 2005, Massport expanded the traffic study area to provide additional information to Bedford officials exploring options to address the Great Road traffic conditions. Chapter 6, Ground Transportation provides more information on the landside roadways around Hanscom.

4.2.3.2 Concord

The Town of Concord adopted its comprehensive long-range plan, *A Vision for 2020*¹⁹ in 2005. This is the first time Concord had completely updated its town plan since 1973-74. The 13 sections in the Concord comprehensive plan are Vision for 2020, land use, housing, economic development, cultural and historic resources, natural resources, open space, recreation, facilities and services, transportation and circulation, fiscal resources, governance, and implementation.

Concord wants to ensure that undeveloped Massport lands are preserved and used for agricultural purposes. There has been no demand for this type of use on Massport property; however, Massport will continue to entertain proposals for agricultural uses at appropriate locations at Hanscom Field that do not conflict with FAA recommendations for aviation safety and security, such as avoiding land uses in the vicinity of the runway that attract bird or other wildlife. Massport has made available 1.8 acres of land in Concord to Gaining Ground, a non-profit organic farming organization, for agricultural use.

Concord is also concerned about stormwater runoff in the Old Bedford Road area. Massport is committed to limiting the effect of stormwater runoff from new development on Hanscom Field through best management practices (BMPs). Between the 2000 and 2005 *ESPR*'s, Massport eliminated approximately 4.4 acres of impervious surfaces at Hanscom Field by removing unused airside pavement. Since the 2005 *ESPR*, no further removal has occurred.

Concord has also expressed an interest in exploring opportunities to expand the regional network of trails and bicycle paths in the town. Chapter 6, Ground Transportation identifies the current location of paths and trails near Hanscom Field, and illustrates a potential opportunity for future connections. As described in Chapter 12, Environmentally Beneficial Measures, Massport will work with the Town of Concord to evaluate this opportunity. Massport has identified and marked a trail across Hanscom land connecting Gaining Ground in Concord with Bedford Conservation Areas. This work was agreed to as part of the Bedford Conservation Commission's approval of vegetation management activities in the Jordan Conservation Area to remove airspace obstructions.

In Concord, Massport has worked through the appropriate local processes to address environmental issues related to the airport, such as the VMP. Since adoption of the VMP in 2004, Massport has implemented it in accordance with Concord's Order of Conditions. Chapter 9, Wetlands Wildlife and Water Resources, includes additional information about the VMP and conservation and recreation lands in Concord.

In January 2011, Massport received an Order of Conditions from the Concord Natural Resources Commission for vegetation removal allowing Massport to remove vegetation obstructions on properties owned by the Concord Land Trust and at an adjacent office park in February.

¹⁹ Town of Concord, *Comprehensive Long Range Plan: A Vision for 2020*, March 2005

Concord's primary goal outlined in its comprehensive plan is protecting its scenic quality and historical significance, as well as the rural character of its roads, such as Virginia Road. Chapter 10 of the 2012 *ESPR* provides a review of cultural and historical resources and potential effects on them from Hanscom.

4.2.3.3 Lexington

Given its proximity to Hanscom Field and the AFB relative to Metropolitan Boston, the Town of Lexington is focused on potential transportation impacts of Hanscom and works with Massport to attempt to mitigate impacts from proposed development and air travel, and improve vehicle traffic safety at intersections that are high-accident locations. Lexington finalized the transportation component of its comprehensive plan in 2003.²⁰ Four elements had previously been completed and were adopted by the Lexington Planning Board on January 30, 2002: land use, housing, economic development, and natural and cultural resources.²¹

In 2010, Lexington revised its zoning on Hartwell Avenue to allow greater density for commercial development. The Hartwell Avenue Transportation Management Overlay District (TMOD) provides for increased development density within its boundaries to spur redevelopment of existing commercial properties. The goal of the TMOD is to increase the assessed value and tax revenues associated with commercial properties along Hartwell Avenue.

Massport has worked through the appropriate local processes in Lexington to address environmental issues, such as the VMP. Chapter 9, Wetlands Wildlife and Water Resource, includes additional information about the VMP and conservation and recreation lands in Lexington.

The critical community priority for Lexington is preserving the quality of life for town residents by protecting and promoting the community's character and beauty. Another area of concern for Lexington is the decline in housing diversity, which is largely in response to rising home prices and the growth of large, expensive new homes. The town hopes to increase diversity by broadening the opportunities to produce good housing through a variety of planning measures such as mixed-use development and better public transportation infrastructure. The Town adopted a TDM policy on September 16, 1998 that seeks to reduce the use of single-occupancy vehicles.

4.2.3.4 Lincoln

Lincoln is the smallest of the four towns in terms of population and economic base. The Town of Lincoln Comprehensive Long-range Plan was accepted at a special town meeting on October 17, 2009²². The plan presents issues, goals, and recommendations pertaining to the following sections: land use and zoning, natural resources, cultural and historic resources, the built environment, open space, housing, economic development, transportation and circulation, community services and facilities, and governance. The Town Vision Statement of Lincoln states, "Lincoln is a town that cherishes its rural, agricultural character, its small town heritage, its open space, and its historical legacy."

Hanscom AFB and Hanscom Field make up approximately 8 percent of Lincoln's land area, at approximately 544 and 117 acres, respectively. Any changes in the status of the AFB or traffic at Hanscom would have an impact on the town. A goal of the plan is to continue to monitor the status of

²⁰ Town of Lexington, *The Lexington We Want: Transportation Element*, 2003.

²¹ Town of Lexington, *The Lexington We Want: The First Four Elements*, 2002.

²² Town of Lincoln, *Comprehensive Plan*, September 22, 2009.

Hanscom AFB with respect to military housing, through base closure or privatization of existing housing that may place new demands on Lincoln's municipal and school services.

Massport supports the continued use of agricultural land for agricultural purposes; however, Massport has not seen adequate demand for this type of use on its property. Massport will continue to entertain proposals for agricultural uses at appropriate locations on Hanscom Field property. Through the *ESPR* process, Massport identifies appropriate TDM and traffic management measures that do not require physical changes to the roadway network and that will preserve the scenic and rural nature of Lincoln's roads including Route 2A.

In Lincoln, Massport has worked through the appropriate local processes to address environmental issues, such as the Order of Conditions on the VMP. Chapter 9, Wetlands Wildlife and Water Resource, includes additional information about the VMP and conservation and recreation lands in Lincoln.

4.2.3.5 HATS Master Plan

The Hanscom Area Towns Master Plan (HATS Master Plan)²³ was prepared in July 1997, soon after the completion of the *1995 GEIR*. The plan was a collaborative effort of the four towns and addressed land use and development policies; land conservation, open space, and recreation policies; MMNHP goals and current initiatives; cultural and historical issues; transportation policies; public transportation and private sector initiatives; and economic parity and fiscal policies, and zoning policies. The purpose of the HATS Committee is to coordinate policies and activities of Bedford, Concord, Lexington, and Lincoln in their relationships with the major organizations that operate at Hanscom. The *2012 ESPR* is responsive to the HATS Master Plan insofar as it applies to Hanscom Field.

As described in this *2012 ESPR*, Massport takes a comprehensive approach to managing airfield operations at Hanscom Field and protecting natural resources. Massport has implemented many recommendations of the Hanscom Noise Workgroup and is pursuing TDM approaches as a MassRIDES partner. Massport has periodically met with NPS to discuss issues of concern and to identify historic resources as described in Chapter 10, Cultural Resources.

In 2001, Massport initiated a "Fly Friendly" Program to reduce noise over the MMNHP. In 2009, a new flight pattern was implemented that keeps aircraft closer to the airfield rather than over sensitive park areas. Prior to this initiative, most touch-and-go operations on Runways 11-29 and 5-23 circled to the south of the airport, over areas of the Battle Road Trail that are used for outdoor programs and interpretive talks. In a partnership involving coordination with the MMNHP, the FAA, the flight schools, and the pilots at Hanscom, it was determined that small aircraft would reduce the flight pattern in a touch-and-go operation that would provide a larger buffer between training operations and the MMNHP.

Similar to the *2005 ESPR*, the future scenarios in the *2012 ESPR* describe potential additional aviation and aviation-related uses on the airport and retain many areas in their current, natural state. Non-aviation uses, including the Aviation Museum and a hotel, are also identified. These types of uses are anticipated to include environmentally friendly designs that would be compatible with the HATS Master Plan.

4.2.4 Key Stakeholders

In addition to the associated municipalities, Hanscom also has two key stakeholders who are central partners to airport planning. Both the MMNHP and Hanscom AFB are direct abutters of Hanscom Field.

²³ Hanscom Area Towns Committee, *Hanscom Area Towns (HATS) Master Plan*, July 1997.

Activities proposed on the airfield and on their properties has a direct impact on the others. As a result, Massport engages with the NPS and the USAF periodically to discuss mutually beneficial projects to improve the mission of each organization.

4.2.4.1 Minute Man National Historical Park

The MMNHP, created in 1959 and operated by the NPS, consists of three discontinuous units—Battle Road, Wayside, and North Bridge. This park covers approximately 967 acres spread out along Route 2A in Concord, Lexington, and Lincoln. The MMNHP is nationally significant as the site of the Battle of Concord - one of the first battles of the Revolutionary War, for its association with prominent literary figures of the 19th and 20th centuries, and as one of the earliest places in the nation to be commemorated.

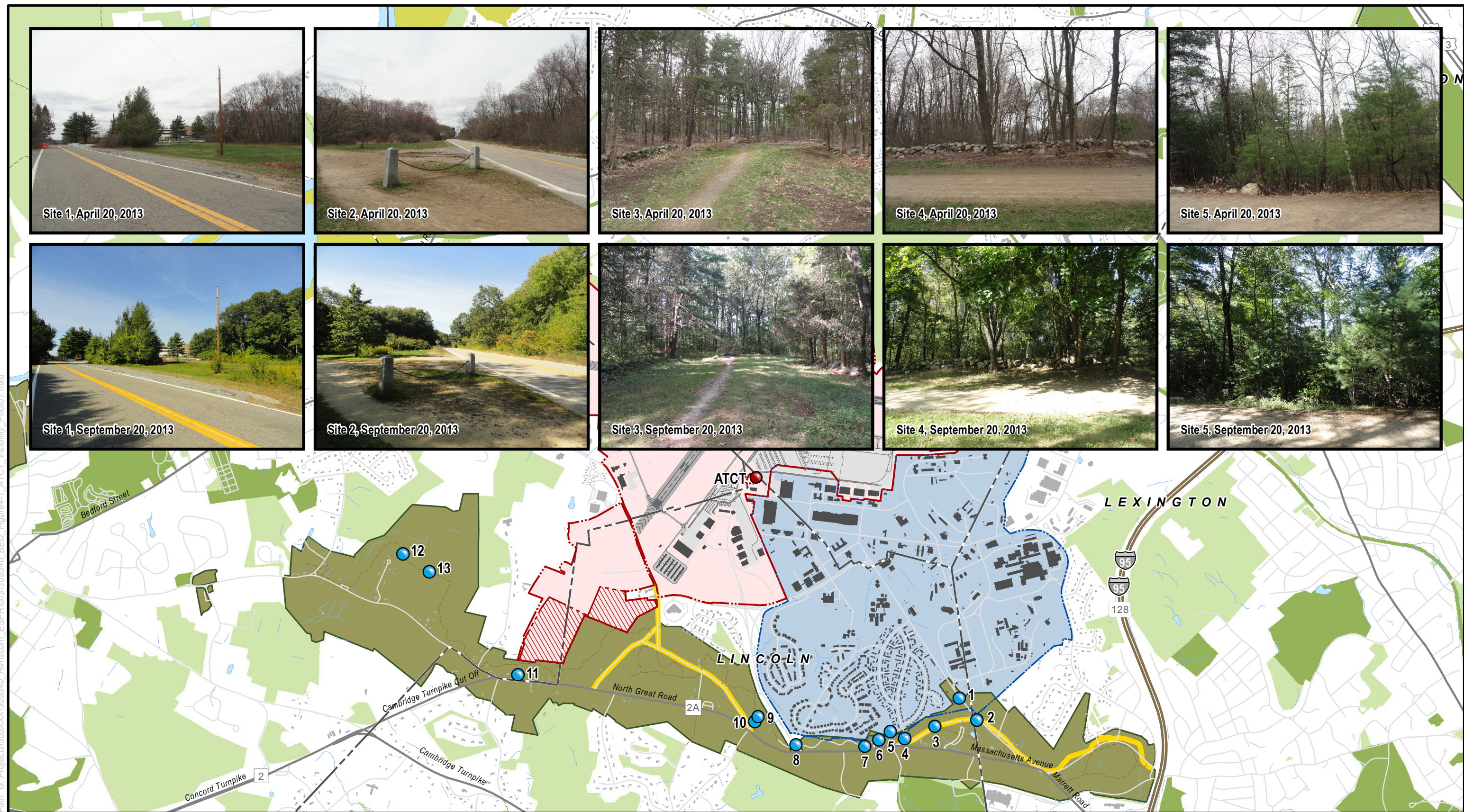
The NPS reports that an estimated one million people visit the MMNHP annually, and it anticipates that annual visitations will continue at current levels. While the park is open year round, its main season is the 7-month period between April and October. Major attractions are the North Bridge area in Concord and Battle Road in Concord, Lexington, and Lincoln. Two parking lots at the North Bridge unit and one at the Visitor Center in the Battle Road unit accommodate automobile and bus parking; six other parking lots are located in the park. Chapter 10, Cultural Resources provides additional information about the MMNHP.

The congressionally approved boundaries of the MMNHP abut the southern boundary of Hanscom Field and include approximately 48.5 acres of Massport property in the Runway 5 Approach Area. To assess the visibility of Hanscom on the MMNHP Battle Road Interpretative Trail, a photographic inventory was conducted for the *2005 ESPR* and repeated for the *2012 ESPR* to identify areas of potential visibility particularly related to the Air Traffic Control Tower (ATCT), which is the tallest structure at Hanscom. The inventory was conducted from the Battle Road Interpretive Trail on April 20 before foliage appeared on trees, and on September 20 with tree foliage.

Despite the close proximity of the park to the airport, Hanscom Field is not visible from most of the Battle Road Interpretive Trail (see Figures 4-1 to 4-3). The FAA ATCT can be seen through the vegetation from scattered locations along the trail and in areas near Meriam's Corner when there is no foliage. A small portion of the airport is visible from an area near Hanscom Drive. However this view is obscured when there is foliage on the trees.

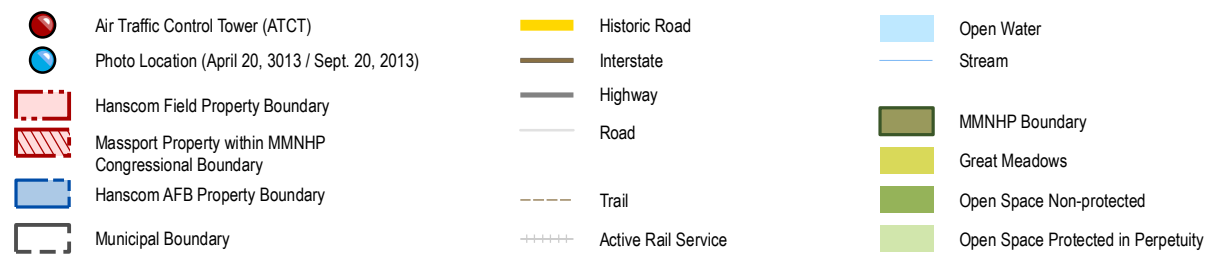
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The Air Traffic Control Tower (ATCT) is visible, or partially visible from photo locations 6 and 7 in the April (Leaf-off) condition.

Data Sources: ESRI (USGS Topographic Maps), March 4, 2013; MassGIS (Community Boundaries), March 5, 2013; PAL, Inc. (Noise Sensitive Receptors), August 28, 2013

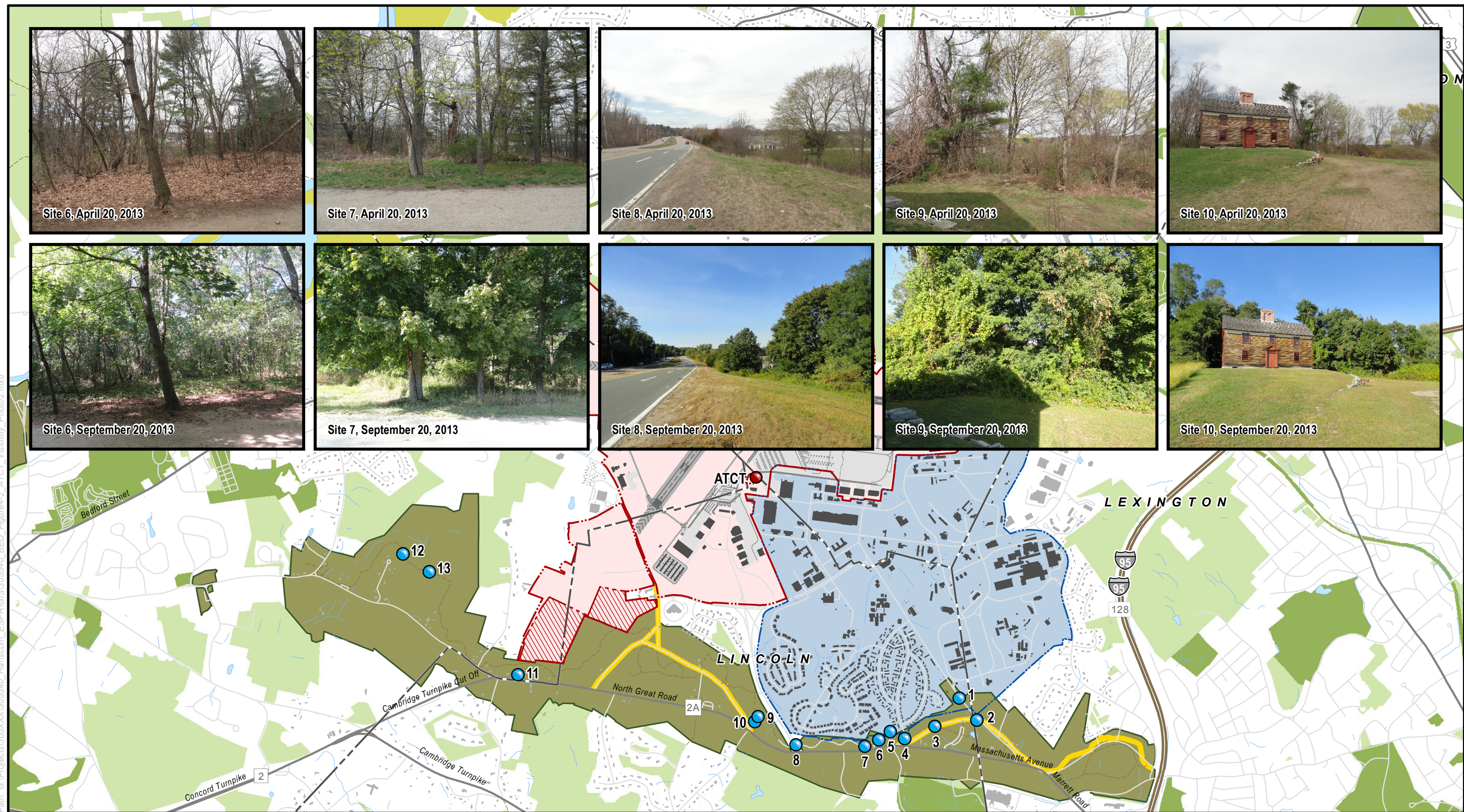


Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Views from Battle Road Trail
Sites 1 to 5

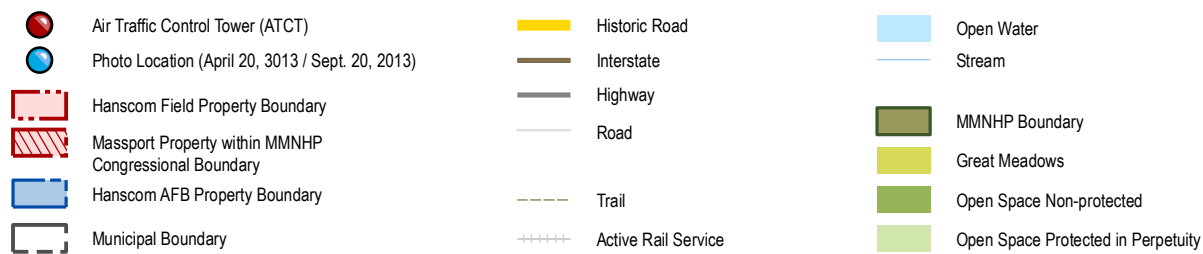
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The Air Traffic Control Tower (ATCT) is visible, or partially visible from photo locations 6 and 7 in the April (Leaf-off) condition.

Data Sources: ESRI (USGS Topographic Maps), March 4, 2013; MassGIS (Community Boundaries), March 5, 2013; PAL, Inc. (Noise Sensitive Receptors), August 28, 2013



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Views from Battle Road Trail
Sites 6 to 10

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The Air Traffic Control Tower (ATCT) is visible, or partially visible from photo locations 6 and 7 in the April (Leaf-off) condition.

Data Sources: ESRI (USGS Topographic Maps), March 4, 2013; MassGIS (Community Boundaries), March 5, 2013; PAL, Inc. (Noise Sensitive Receptors), August 28, 2013

- | | | | | | |
|--|---|--|---------------------|--|------------------------------------|
| | Air Traffic Control Tower (ATCT) | | Historic Road | | Open Water |
| | Photo Location (April 20, 2013 / Sept. 20, 2013) | | Interstate | | Stream |
| | Hanscom Field Property Boundary | | Highway | | MMNHP Boundary |
| | Massport Property within MMNHP Congressional Boundary | | Road | | Great Meadows |
| | Hanscom AFB Property Boundary | | Trail | | Open Space Non-protected |
| | Municipal Boundary | | Active Rail Service | | Open Space Protected in Perpetuity |



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Views from Battle Road Trail
Sites 11 to 13

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The preservation of Battle Road, which makes up 80 percent of the Park, is of particular importance to the NPS. The potential impacts of transportation activity from Hanscom and Route 2A are important issues for managing the Park. Massport has continued a dialogue about potentially feasible environmentally beneficial measures that would help address potential concerns. In accordance with this effort, Massport met with the NPS on May 23, 2013 to discuss the 2012 *ESPR* and necessary updates. Of notable significance, the NPS acquired the Barrett's Farm and 3.4 acres of land and added it to the North Bridge Unit of the MMNHP since the 2005 *ESPR*. The MMNHP staff also reviewed the proposed historical and interpretative locations for the 2012 *ESPR*'s noise assessment.

Aircraft noise is a concern for many Hanscom area residents and the MMNHP. Massport recognizes the importance of proactively addressing this issue and is committed to continuing its current noise-related programs while exploring appropriate new initiatives. In response to the residential community's aircraft noise and operational concerns, Massport adopted regulations (Part F of the General Rules and Regulations for Laurence G. Hanscom Field) in 1980. Most of these programs could not be duplicated or changed under current federal law. They include the following:

- A nighttime field use fee to help discourage activity between 11 p.m. and 7 a.m.
- A restriction on scheduled commercial air carrier service to aircraft with no more than 60 seats
- Restrictions on touch-and-go activity (aircraft operations conducted to repeatedly and consecutively practice landing and departing techniques) by weight of aircraft and time of day. Touch-and-go operations are not permitted between the hours of 11:00 pm and 7:00 am.
- A phase out of most Stage 1 aircraft (some of the noisiest aircraft in the U.S. fleet) at Hanscom
- Limitations on auxiliary and ground power unit use including a 30-minute operation limitation.

Massport periodically meets with NPS to discuss issues of concern and to identify historic resources as described in Chapter 10, Cultural Resources. In 2001, Massport initiated a "Fly Friendly" Program to reduce noise over the MMNHP. In 2009, a new flight pattern was implemented specifically to keep the aircraft closer to the airfield rather than over sensitive park areas. Prior to this initiative, most touch-and-go operations on Runways 11-29 and 5-23 circled to the south of the airport, over areas of the Battle Road Trail that are used for outdoor programs and interpretive talks. In a partnership involving coordination with the MMNHP, the FAA, the flight schools, and the pilots at Hanscom, it was determined that small aircraft would reduce the flight pattern in a touch-and-go operation that would provide a larger buffer between training operations and the MMNHP.

4.2.4.2 Hanscom Air Force Base

Hanscom AFB, which directly abuts Hanscom Field on the southern side of the airfield, occupies approximately 846 acres of land. Hanscom AFB and the firms that do business at the Base are important employers in the region. More than 3,000 active duty, Reserve, and National Guard military personnel and Department of Defense civilians work and live at Hanscom AFB. According to information published by the Hanscom AFB, as of May 2013, the total estimated Economic Impact is approximately \$6.2 billion. Primary Hanscom jobs are over 5,500 and secondary jobs created are over 14,500.²⁴

Hanscom AFB operates as a research and development office park with approximately 732 residential units. The 66th Air Base Group is headquartered at Hanscom AFB, which is part of the USAF Life Cycle

²⁴ <http://www.hanscom.af.mil/library/factsheets/factsheet.asp?id=7493>

Management Center. The Life Cycle Management Center is responsible for total life cycle management of USAF weapon systems.

On November 5, 2012, the Massachusetts National Guard Joint Force Headquarters became operational at Hanscom. This group serves as an administrative complex to support state and federal missions of the State's National Guard. In addition, the Massachusetts Institute of Technology proposed a research facility at Hanscom AFB to design small electronic components for use in emerging aerospace, communications, and missile technologies. In 2012, the Pentagon approved the plan.

Because the Hanscom AFB directly abuts Hanscom Field, Massport has placed greater importance of working with the USAF on areas of common concern and benefit. This relationship has focused on TDM actions, including relocating a Massachusetts Bay Transportation Authority bus stop shelter from the Hanscom AFB to Massport property to accommodate Hanscom AFB transit patrons and establishing shuttle services to Concord Center commuter rail station.

In 2005, the Base Realignment and Closure (BRAC) Commission reviewed Hanscom AFB for closure as part of BRAC process. Massport worked closely with State and local officials to advocate for keeping the Base open. Opportunities to add new research and development, office space, and residential units on the Base and to create the opportunity for the USAF to expand the mission of the Base were identified. As part of this effort, MassHighway identified transportation improvements to the Hartwell Avenue corridor that would improve access to Hanscom AFB. The BRAC Commission decided to maintain Hanscom AFB as a military facility.

In the development of the *2012 ESPR*, Massport reviewed the landside roadways that provide access to the main AFB gate and security checkpoint, including a new location for the Vandenberg Gate under consideration by Hanscom AFB, in consultation with the Massachusetts Department of Transportation (MassDOT), MassDevelopment, and Massport. The new roadway and gate structure would replace the one at the intersection of Old Bedford Road, Vandenberg Drive, and Hanscom Drive with a roundabout. Along with the improvements to the roadways, a bicycle lane would be included in the design to increase the safety of cyclists.

4.2.5 Metropolitan Area Planning Council Regional Plan

The MAPC is the regional planning agency for metropolitan Boston, representing 101 cities and towns. MAPC encourages sustainable development practices. The primary areas of focus are land use, transportation, economic development, housing, environment, public safety, and municipal administration. The most recent plans drafted by the MAPC are the MetroPlan 2000²⁵, MetroFuture in 2002, and the MetroFuture in 2009.²⁶

The MetroPlan 2000 “encourages efficient development by promoting compact development patterns and discouraging sprawl.” MetroPlan provides guidance to reduce the adverse environmental impacts of sprawl and to protect natural resources. The plan identifies three development areas that are distinguished by different land use densities and sewer services. Hanscom Field, which is connected to sewer service, is located within a “Multi-Service Area” as defined in MetroPlan. In addition to the MetroPlan, the MAPC initiated MetroFuture: Making a Greater Boston Region in 2002.

²⁵ Metropolitan Area Planning Council, *MetroPlan 2000: A Plan for Future Growth*, 1990.

²⁶ Metropolitan Area Planning Council, *MetroFuture: Regional Plan*, 2008.

In concert with these two plans, the MAPC's 15 Smart Growth principles provide a framework for guiding changes in the Greater Boston Region. Per the plans, "smart growth will refocus a larger share of regional growth within central cities, urbanized areas, near transportation nodes, and in communities already served by infrastructure." Hanscom Field is an existing resource that is served by existing infrastructure. The future scenarios that are described in the *2012 ESPR* make efficient use of these existing resources to satisfy a demand that is generated by nearby residential and commercial activities. The current and future use of Hanscom Field is consistent with Smart Growth principles. Table 4-4 presents MAPC's 15 Smart Growth principles and their relationship to Hanscom Field.

MAPC most recently released *MetroFuture*, a 30-year plan that serves as a guide for the work in all areas of the agency. The *MetroFuture* plan supports a vision of smart growth and regional collaboration through the promotion of efficient transportation systems, conservation of land and natural resources, improvement of the health and education of residents, and an increase in equitable economic development opportunities for prosperity. *MetroFuture* identified 65 "Goal Statements" that are specific to Metropolitan Boston, and not specifically applicable to Hanscom. Noteworthy goal statements as they may pertain to future planning at Hanscom include:

1. Population and job growth will be concentrated in municipalities already well served by infrastructure, with slower growth in less developed areas where infrastructure is more limited.
5. Most new homes and jobs will be near train stops and bus routes, and new growth will be designed to promote transit use.
9. The region's landscape will retain its distinctive green spaces and working farms.
23. All neighborhoods will have access to safe and well-maintained parks, community gardens, and appropriate play spaces for children and youth.
36. Businesses will grow expeditiously thanks to consistent and predictable economic development policies set by an informed public sector.
37. A strong supply of educated and skilled workers—of all ages—will encourage businesses to locate and expand here.
44. An expanded transit system will provide better service to both urban and suburban areas, linking more homes and jobs.
46. Commuters will have more options to avoid congestion.
47. Most people will choose to walk or bike for short trips.
49. Outlying areas will see little increase in traffic congestion.
51. Regional transportation planning will be linked with sustainable land use planning.
52. The transportation system will be reliably funded and transportation agencies will demonstrate accountability to the public.
55. The region's businesses will access the global marketplace through an efficient freight transportation network.

Table 4-4 MAPC Smart Growth Principles

Principle	Response/Applicability
#1 Encourage community and stakeholder collaboration in development decisions.	Massport is engaged in on-going meetings and discussions with the four towns through the Hanscom Field Advisory Commission.
#2 Integrate people and place.	Not Applicable. This principle is oriented toward development within communities.
#3 Promote regional equity and reduce local and regional disparities.	The presence of air travel at Hanscom Field offers a service for people in the surrounding region who would otherwise be traveling greater distances to use a facility elsewhere, and it reduces air traffic at other regional facilities.
#4 Strengthen regional cooperation.	Massport is engaged in on-going community discussions through the Hanscom Field Advisory Commission (HFAC) process. Massport continues to work cooperatively with the EEA and the Shawsheen Watershed partners to improve the Shawsheen River water quality and to reach out to Hanscom AFB and the NPS on issues of common concern.
#5 Promote distinctive, attractive communities with a strong sense of place.	The ESPR provides a comprehensive evaluation of the cumulative environmental effects of Hanscom Field and a retrospective analysis of changes at the airport. The ESPR process provides a framework to identify and plan for potential environmental effects at the airport and in the surrounding communities.
#6 Preserve open space, farmland, and critical environmental resources.	Massport manages the environmental resources at Hanscom Field to address issues related to wetlands, watersheds, and drinking water supplies. Locations for potential agricultural use have been identified if demand warrants.
#7 Encourage development in currently developed areas to take advantage of existing community assets.	Hanscom Field is an existing resource that is well served by existing infrastructure.
#8 Mix land uses.	Hanscom Field incorporates a mix of land use consistent with airport use.
#9 Take advantage of compact development design and create walkable neighborhoods.	Massport seeks to make effective use of existing impervious surface, utility systems and built areas at Hanscom Field.
#10 Promote economic development in ways that produce jobs, strengthen low and moderate-income communities, and protect the natural environment.	Hanscom Field supports air travel needs of existing businesses along Route 128 and provides jobs for area residents. National Aviation Academy, one of Massport's tenants at Hanscom Field, provides training for technical jobs in the aviation industry. Massport is a responsible manager of environmental resources at Hanscom Field. Massport requires third-party development as well as its own development at Hanscom Field to achieve the US Green Building Council's Leadership in Energy and Environmental Design (LEED) Certification.
#11 Create a range of housing opportunities and choices in cities and towns throughout the region.	Not Applicable.
#12 Promote more transportation choices through the appropriate development of land.	Hanscom Field satisfies a regional demand for air travel for people in the surrounding region who would otherwise be traveling greater distances to use a facility elsewhere. Massport has also been working with the AFB to enhance the TDM programs available to employees.
#13 Develop predictable, fair, and cost effective regulatory approvals for smart growth oriented developments.	Not Applicable
#14 Encourage fiscal policies that support smart growth.	Not Applicable
#15 Enable smart growth by reforming existing zoning.	Not Applicable

Source: MAPC, Smart Growth Principles for the Metropolitan Area Planning Commission, February 2003

4.3 Description of Planning Areas

For purposes of the *2012 ESPR*, Hanscom Field has been divided into six planning areas based on geographic considerations to facilitate the discussion of planning for future aviation-related facilities at Hanscom and the evaluation of the conceptual development scenarios (see Figure 4-4). The planning areas are referred to as:

- Terminal Area
- ATCT Apron
- East Ramp
- North Airfield
- Pine Hill
- West Airfield

The Pine Hill and West Airfield areas are provided for consistency with past ESPRs. No new development is foreseen in these three planning areas at this time. Any new development would be consistent with what was presented in the *2005 ESPR*. The ATCT Apron is a new planning area identified in this ESPR.

Each area is divided between airport function referred to as landside and airside. The landside area at Hanscom Field is the area that is located outside the Secure Identification Display Area (SIDA) that is generally accessible to the public. Examples of landside facilities include the roadway system, the parking lot in front of the Civil Air Terminal. Airside includes areas within the SIDA, which are located in a secure environment with controlled access. Examples of airside facilities include runways, taxiways, and aircraft parking areas. Some structures like the Civil Air Terminal and hangars commonly have both landside and airside components, distinctly segregated.

Third-party developers undertake the majority of development at Hanscom Field. In preparing the ESPR and looking at locations for future development, Massport must take into account a range of aviation development types. This requires Massport to have a variety of sites and different locations available in order to accommodate future development opportunities. To do this, Massport looks to areas at Hanscom Field that can be developed with the fewest environmental impacts. The development areas that are shown in the ESPR will provide market-driven development opportunity to third-party developers.

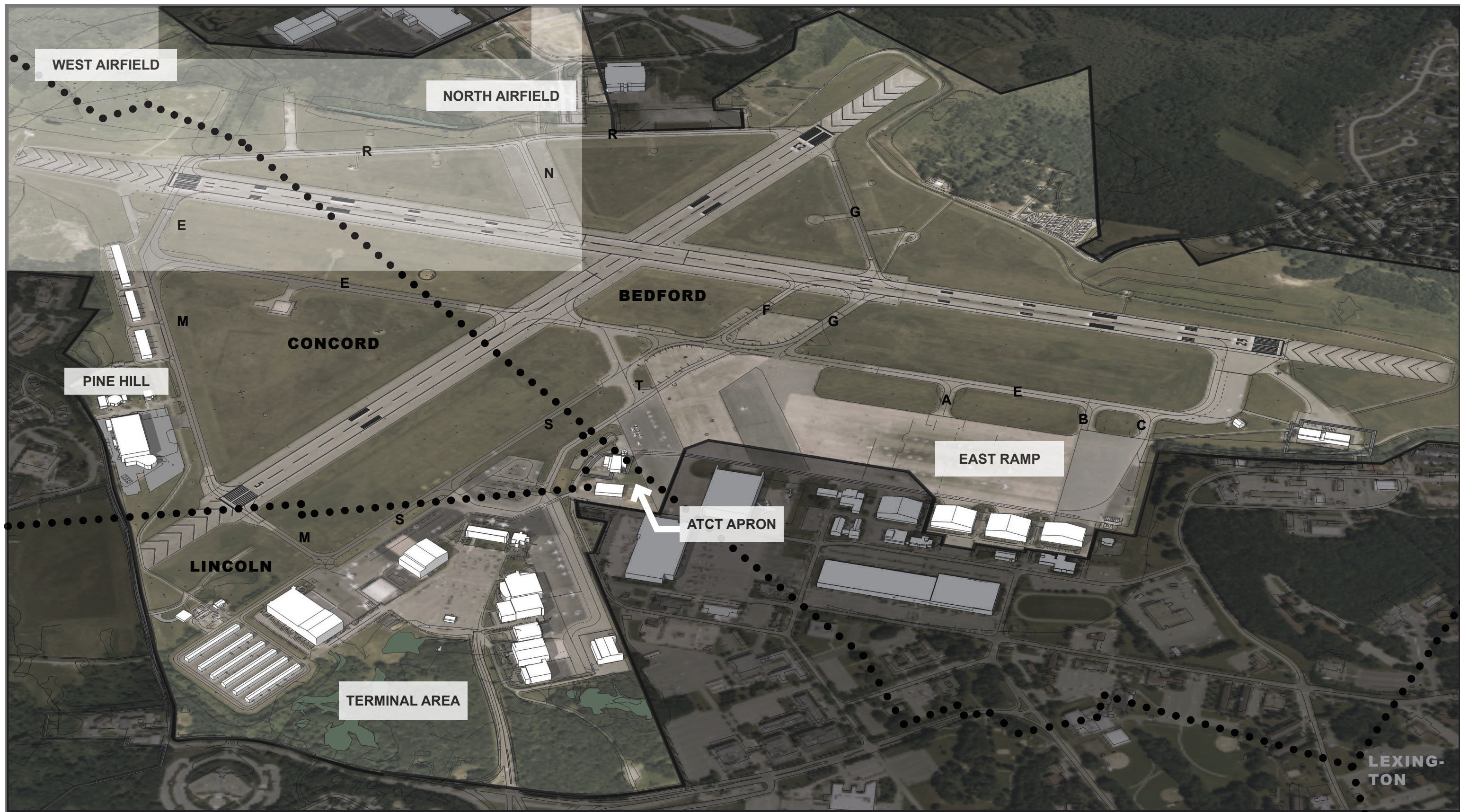
4.3.1 Terminal Area

The Terminal Area includes a mix of terminal, airside, and landside functional areas. Specific facilities include the Civil Air Terminal and supporting facilities, such as public parking, FBOs, flight schools, airport maintenance facilities, fuel farms, and several privately operated facilities. The Terminal Area is bounded to the southwest by Virginia Road and the Runway 5 Approach, to the west by Runway 5-23 and Pine Hill, to the north by Runway 11-29, to the northeast by the East Ramp, to the east by the Hanscom AFB, and to the south by Old Bedford Road and the Town of Lincoln. Access to the Terminal Area is provided by Hanscom Drive and Old Bedford Road.

4.3.2 Air Traffic Control Tower Apron

The Air Traffic Control Tower (ATCT) Apron area is confined to a small parcel of land that surrounds the FAA's ATCT. It includes the ATCT and associated parking lot, which is FAA property, the aircraft maintenance building, and adjacent apron area. It is between the Terminal and the East Ramp and abuts

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the airfield to the north and west, and the Hanscom AFB to the south and east. The entire ATCT and Apron is contained within secure areas. Current physical access is from the Terminal.

4.3.3 East Ramp

The East Ramp area includes a large developed area for aircraft maneuvering, parking, servicing, fueling, and tie-downs. Common land uses in the East Ramp Area include hangars, ramp parking, and support activities associated with the Hanscom AFB. Five existing hangars form the southern boundary of the East Ramp, two of which are located on Massport property and occupied by an FBO and three of which are within the AFB property boundary. All hangars have direct airside access to the East Ramp, along with dedicated apron frontage.

Additionally, the USAF Fire Department, an FBO fuel farm, and Massport's fueling facility are located in this area. Other facilities include Massport's maintenance garage and sand storage building, FAA equipment storage, navigational aids, and a U.S. Customs and Border Protection (CBP) trailer.

Massport does not have direct vehicle landside access to the East Ramp. Currently the USAF controls access through the AFB to the East Ramp. The East Ramp is bounded on the west by Runways 5-23 and the Terminal and Pine Hill Areas; to the north by Runway 11-29, the North Airfield, and a residential neighborhood; to the east by properties located along and off Hartwell Avenue in the Towns of Lexington and Bedford; and to the south by the Hanscom AFB. Any non-military tenants wanting access to the East Ramp must enter the AFB through the main gate.

In 2008, Massport completed a utility study of the East Ramp to identify utility needs for future hangar development on the existing East Ramp. Massport analyzed potential noise and air quality conditions based on hangar development scenarios in this area. These analyses were included with a Massport letter to the FAA requesting a categorical exclusion under NEPA for new hangars on the East Ramp. The FAA considered the cumulative impacts of East Ramp development along with Hangar 24 (Rectrix FBO) redevelopment and ultimately determined that hangar development on the East Ramp is a categorically excluded project.

The evaluation in the 2005 *ESPR* of alternative access routes to the East Ramp including a new road from Hartwell Avenue. Access options through the AFB are unchanged since 2005.

4.3.4 North Airfield

The North Airfield includes property located north of Runway 11-29 and both east and west of Runway 5-23. It is bounded on the far west by the West Airfield and to the north by the Town of Bedford.

Other than runways and taxiways and their supporting infrastructure, airport-related facilities in the North Airfield are limited to two buildings housing the runway glide slope indicators and one building occupied by the runway localizer. Massport had previously leased a large portion of this area to the USAF, but this area has reverted to Massport control. The land was occupied by a trailer park, which provided supplemental housing for the AFB. In 2008, the USAF decided to close the trailer park. In 2009, all structures were removed and by 2010, the USAF had removed all utility poles and ensured that the site was environmentally acceptable for return to Massport in 2011.

Another part of the North Airfield is owned by the U.S. Navy, but was operated by Raytheon until 2000. It includes a hangar, apron, and has direct access to the airfield. Massport has been working with the

Government Services Administration (GSA) to obtain control of the Navy Hangar site and filed an application for formal transfer of the property in 2012. It expects to receive the land in 2014.

In 2012, Edge Sports leased a portion of the North Airfield site north of Hartwell Road owned by Massport and constructed two turf athletic fields adjacent to their existing facility. These fields were completed in 2013.

4.3.5 Pine Hill

The Pine Hill primarily consists of an airside secured area with limited landside access to several facilities. It includes the facilities previously occupied by the Massachusetts Institute of Technology and now being developed by the FBO Rectrix Aviation (previously known as Hangar 24), three T-hangar facilities adjacent and parallel to Taxiway M, and the Draper Labs. The Pine Hill is bounded to the southwest and west by Virginia Road and the Runway 5 Approach, to the northwest by the West Airfield, to the north by Runway 11-29 and the North Airfield, and to the east and southeast by Runway 5-23, the East Ramp, and Terminal Area. Access to the Pine Hill is provided by Virginia Road.

Massport explored future development opportunities in the Pine Hill in the *2005 ESPR*. No updates to that work are provided in this *ESPR*.

4.3.6 West Airfield

The West Airfield extends west from the approach end of Runway 11. It is bounded to the south, west, and north by the Towns of Concord and Bedford, and to the east by Pine Hill and North Airfield.

This area is largely undeveloped and contains a significant amount of wooded area, wetlands, wetland buffers, and vernal pools, and is traversed by Elm Brook. There is a conservation easement over a portion of this area held by the Town of Concord, which constrains future development. This area has more variable terrain than most other portions of the airport. In addition, Massport marked a number of trails in the West Airfield that connect to the Town of Bedford conservation land trails as well as to Gaining Ground in Concord. This work was conducted in accordance with an agreement with Bedford to remove vegetation obstructions in the Jordan Conservation Area.

Massport explored future development opportunities in the West Airfield in the *2005 ESPR*. No updates to that work are provided in this *ESPR*.

4.4 Current Planning Initiatives and Projects

Massport has implemented programs to promote environmental quality at Hanscom Field. The ISO 14001 Certification of Hanscom Field recognizes Massport's progressive environmental programs and policies, including BMPs. Massport voluntarily subscribes to the guidelines of Executive Orders 385 and 438 as described below and supports the more efficient use of Hanscom Field within the broader context of growth management and sustainability.

Massport is a leader among Massachusetts agencies in promoting and implementing sustainable designs. New hangar facilities at Hanscom Field must achieve the US Green Building Council's Leadership in Energy and Environmental Design (LEED) Silver Certification. Logan Airport's Terminal A was the first terminal in the world to achieve LEED Certification. Massport will continue to require future development of airport facilities at Hanscom Field, such as any future hangar development in the North

Airfield and the East Ramp to achieve LEED Silver certification. Rectrix is constructing its new facility as a LEED Silver certified hangar.

Massport meets monthly with the Hanscom Field Advisory Commission (HFAC) to review activities at Hanscom Field. HFAC is an advisory commission that was established by the state legislature in 1980. HFAC includes 16 members appointed by different constituencies and approved by the selectmen of Bedford, Concord, Lexington, and Lincoln. HFAC includes representatives from the Towns of Bedford, Concord, Lexington, and Lincoln; local citizens groups; other area towns affected by Hanscom Field; businesses basing aircraft at Hanscom Field; aviation or aviation-related businesses at Hanscom Field; and business-aviation general aviation organizations. The HFAC process affords the opportunity for review of projects that are not subject to formal MEPA review.

As summarized in this section, Massport has initiated a number of projects since the 2005 *ESPR* including third-party redevelopment of the Hangar 24 site, rehabilitation of existing apron pavement, increased security measures around the airfield, and continued maintenance activities at Hanscom. This section summarizes current planning initiatives and projects within Hanscom's airside and landside areas, elements of Massport's 5-year capital program at Hanscom Field, and FAA and Massport security policies and projects that could have environmental effects. These planning initiatives and projects are listed in Table 4-5 along with an indication of the expected need for MEPA review. Massport will continue to use the *ESPR* process to describe planned and potential projects and review the potential applicability of MEPA review.

Table 4-5. Current Hanscom Field Planning Initiative Projects

Planning Area	Current Planning Initiative/Projects ¹	Description/Status	MEPA Review
Terminal Area	Salt Storage	Salt Storage Enclosure	None anticipated
	Pine Hill	T-Hangar Apron Rehabilitation	None anticipated
	Terminal Apron	Rehabilitate old T-hangar pavement	None anticipated.
	Roadways	Rehab Landside Roadways	None anticipated
	Terminal Enhancement	Replace windows and HVAC units First Floor of CAT	None anticipated
East Ramp	East Ramp	Joint Repair	None anticipated
	Taxiway J Maintenance	Rehabilitate Taxiway J	None anticipated
North Airfield	Perimeter Road	Relocated portions of perimeter road	Possible MEPA filing
Pine Hill	Pavement Maintenance	Rehab T-hangar pavements	None anticipated
Other	Taxiway G upgrade	Taxiway G upgrade	Possible MEPA filing
¹ Massport, <i>The State of Hanscom</i> , March 2013. FY13-FY17 Capital Projects			

4.4.1 Five-Year Capital Improvement Program

Massport's 5-year capital program spanning from FY13 to FY17 includes various projects such as perimeter road enhancements, taxiway and apron pavement rehabilitations, terminal enhancements, and new equipment and storage for materials.

Between 2005 and 2012, one project required MEPA and Conservation Commission review: the Runway 5-23 Safety Area Improvements.²⁷ The RSA project involved regrading turf at the Runway 5 and 23 ends, some of which was in wetland areas. This project did not expand the runway and did not require any additional pavement. On October 18, 2006, MEPA issued a certificate on the Draft EIR for the RSA project and found that the project adequately and properly complied with MEPA. Massport completed the Final EIR for this project and filed it in early 2007. The project was also reviewed by the MassDEP which issued a variance. The project included replication of wetland areas disturbed adjacent to the Runway 23 RSA. The replication areas were located west of Runway 23 and north of Runway 11.

Massport will file an EIR for the projects in the 5-year capital program at Hanscom Field requiring MEPA review. See Table 4-5 for more information specific to each project.

Possible improvements to the Civil Air Terminal will address existing needs of the building tenants. Additional maintenance and repairs for the first floor of the Civil Air Terminal are under consideration.

4.4.2 Third-Party Development

Third parties undertake the majority of development at Hanscom Field. Third-party development that occurs at Hanscom Field is subject to appropriate local, state, and federal review as well as Massport policies. New facilities would be required to meet the Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Standards for water quality and quantity. Massport's policy is to maintain or reduce (not to increase) existing rates of stormwater runoff from Hanscom Field. Massport also requires future development of airport facilities at Hanscom Field to achieve LEED Silver certification. The Rectrix Aviation hangar has been designed to achieve LEED Silver certification.

In preparing the ESPR and looking at locations for future development, Massport takes into account a range of aviation-compatible development types in areas that would result in the fewest environmental impacts. The development areas presented in the ESPR will provide market driven development opportunity to third-party developers. The most recent third-party development ventures are summarized in this section.

In 2011, Jet Aviation submitted a proposal to replace Hangar 17 with a modern hangar and ramp to accommodate the future business jet fleet. Jet Aviation is an FBO currently located at Hanscom that handles a range of needs for based and transient aircraft, operators, and passengers. Services offered include cleaning, maintaining, fueling, parking and hangaring of aircraft, providing pilot flight planning services, and arranging for specific needs of those flying.

The existing 21,315 square foot hangar was constructed in 1945 and is inefficient and undersized for the newer fleet. In 2012, Massport approved Jet Aviation's proposal to include the 40,000 sf replacement hangar with associated office/shop space, a 12,000 square foot FBO facility, approximately 94,000 square feet of apron area, a landside access road, and replacement automobile parking. The new hangar will be connected to the existing ramp via new ramp space.

Although the project was not subject to MEPA, Jet Aviation prepared an Environmental Assessment (EA) under NEPA to disclose the potential human and environmental effects of this proposed action. Jet

²⁷ Massport in conjunction with FAA, *Runway 5-23 Safety Area Improvements Draft Environmental Assessment and Draft Environmental Impact Report*, July 2006.

Aviation will begin the process of seeking individual construction permits in 2014. In accordance with Massport policy, Jet Aviation is designing the facility to achieve LEED Silver certification standards.

In 2012, the Massport Board also approved Rectrix Aviation as the developer for FBO facilities at the Hangar 24 site. Following extensive public review, Rectrix obtained its permits and finished with the demolition of Hangar 24 in September 2012. Rectrix anticipates completion of the project in early 2014.

4.4.3 Security Policies and Projects

As TSA and Massport security policies are formulated and specific projects identified, regulatory approvals might be required. All relevant projects will go through the appropriate environmental process. Massport has installed new security fencing at Hanscom and an enhanced access control system. Massport will add pedestrian gates near the vehicle trap gates and bollards may replace Jersey barriers in front of the Civil Air Terminal. Massport will continue to review all security measures while making appropriate adjustments, as warranted. Massport does not anticipate that these projects would require MEPA review.

4.5 Master Planning

This section describes the characteristics of the potential future planning concepts for the 2020 and the 2030 scenarios. Figure 4-5 illustrates the potential development opportunity areas at Hanscom Field.

The general approach applied in the future scenarios is as follows:

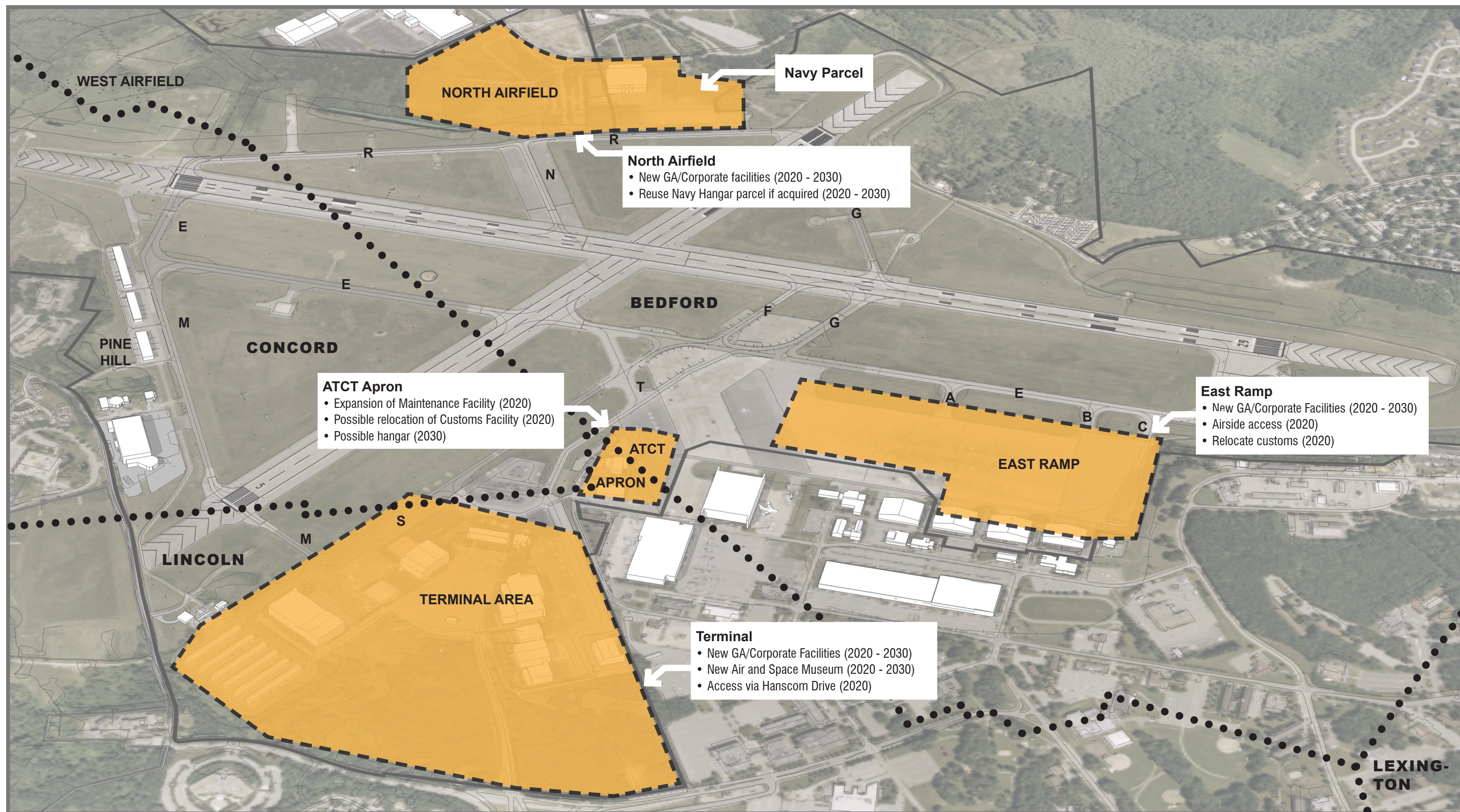
- Enhancing aviation-related facilities on the East Ramp, which includes maximizing the use of the existing apron area,
- Infill development in the Terminal Area, which has existing infrastructure to support new GA facilities, and
- Reusing developed areas in the North Airfield Area that utilize the northern edge of the airport.

The planning concepts shown provide flexibility to respond to the anticipated variability of future demand in a coordinated fashion. The proposed concept layouts are shown for illustrative purposes only and are expected to evolve over time. Detailed environmental analyses would be required for projects that move from conceptual screening to the proposal stage whenever MEPA or other regulatory thresholds are triggered. However, because third-party developers complete most new development at Hanscom Field, Massport's planning must be programmed to be flexible and able to respond to changing conditions and regional demands.

The future airport planning concepts presented here are based on:

- The planning context described in this Chapter,
- Infrastructure conditions discussed in Chapter 2, Facilities and Infrastructure,
- Potential market forces that shape and change demand for airport facilities and infrastructure, and,
- The forecasts of aviation activity levels discussed in Chapter 3, Airport Activity Levels.

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Summary of Planning Areas

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The Master Planning concepts are matched with activity level forecasts for the planning years 2020 and 2030. Table 4-6 summarizes Forecast Aviation Activity Levels described in Chapter 3. It should be noted that:

- Forecast long-term (2030) aircraft operations are 37,000 to 56,000 below the 2005 *ESPR* long-term forecasts.
- Forecast long-term (2030) passenger levels are significantly lower than the 2005 *ESPR* forecast.
- Based aircraft forecast is lower than the 2005 *ESPR* forecasts by approximately 27 to 60 aircraft.

Table 4-6 Summary of Actual and Forecast Activity at Hanscom Field

	Actual 2012	Forecast	
		2020	2030
Aircraft Operations (7:00 am to 11:00 pm)			
General Aviation			
Local (SEP)	70,196	62,605	65,164
Personal Flying (SEP)	51,477	50,661	58,285
Business Non-Jet (MEP + Turbo)	10,178	10,861	12,985
Business Jet	25,638	35,043	46,782
Helicopter	7,345	7,345	7,345
Subtotal GA	164,834	166,515	190,561
Military	745	745	745
Commercial Scheduled Airline¹	635	1,040	1,820
Total Operations	166,214	168,300	193,126
Based Aircraft	340	360	416
Commercial Airline Passengers	8,609	20,280	40,600
<ol style="list-style-type: none"> Total commercial airline operations in 2030 are forecast at 2,080, including 260 operations before 7:00 am. The operations presented in the 2012 <i>ESPR</i> differ slightly from those published in the Hanscom Annual Noise Report. This discrepancy is due to the difference in the timing of the preparation for the two reports. Each report used the best available data at the time of the analysis for that report. The difference of approximately 0.3 daily nighttime operations or 0.07% of all daily operations would change computed noise levels by less than 0.1 dB. 			

Source: Massport and FAA Tower Counts.

As discussed in Chapter 3, Activity Levels, a comparison of the GA activity in the 2020 and 2030 scenarios suggests that GA activity could grow modestly between 2013 and 2030. Much of this growth would be attributable to business jets, which would increase the demand for GA hangars and associated facilities. GA hangars are an interface between landside and airside and will be discussed in the landside section. Forecasts of activity presented in Chapter 3 indicate that single-engine aircraft operations would comprise an increasingly smaller percentage of the general aviation operations than previously forecast.

Similarly, business jet activity would constitute an increasingly greater percentage of the general aviation operations over the forecast period.

Actual numbers of total based aircraft have declined approximately 14 percent from 2000 to 2012, from 397 to 340. Most of the decrease is attributable to reductions in single-engine and multiengine piston aircraft. However, the number of based jets has increased from 24 to 79 in the same period, or an approximate increase of 229 percent. Helicopters have also increased approximately 114 percent.

Total based single-engine and multiengine piston aircraft are forecast to remain relatively constant across the scenarios through 2020, suggesting that the demand for hangar space would remain constant through this same time period. However, based jet aircraft are forecast to grow from 79 in 2012 to 90 in 2020 and to 120 in 2030, therefore increasing the need for GA/corporate hangar and FBO space over the forecast period.

The following discussion of 2020 and 2030 scenarios presents a general context for the future planning of potential GA facility development. The array of GA facilities, which exceeds the GA facility requirements for the 2020 and 2030 scenarios, represents a range of development options that could be pursued in response to changing market forces. The concepts for the Hanscom Field planning areas provide a basis to evaluate the cumulative environmental effects of these options under the 2020 and 2030 scenarios. Table 4-7 summarizes potential planning concepts for the 2020 and 2030 scenarios for each of the Planning Areas.

Table 4-7 2020 and 2030 Hanscom Field Planning Concepts

Planning Area	2020 Scenarios ¹	2030 Scenarios ²
Terminal	GA facilities with new parking spaces Salt storage/maintenance facility Jet Aviation to replace Hangar 17 New access way to Jet's replacement hangar First phase of Air & Space Museum for the Massachusetts Aviation Historical Society Civil Air Terminal enhancements	Second phase of Air & Space Museum New GA hangars Hotel Civil Air Terminal enhancements New and replacement structured public parking spaces as needed
ATCT Apron	Relocation option for customs facility Expansion of the airport maintenance facility Alternative landside access	Further expansion of the airport maintenance facility GA hangar development
East Ramp	Relocation option for customs facility GA facilities with new parking spaces Alternative landside access	Expansion of GA facilities and upgrading or replacement of existing GA hangars Alternative landside access
North Airfield	GA facilities with parking in area with existing parking spaces GA facilities at Navy hangar site once the parcel turns over to Massport	Additional GA facilities at the Navy hangar site
<p>Note: The Pine Hill and West Airfield areas are provided in this ESRP for consistency with past ESRPs. No new development has been evaluated for the 2012 ESRP.</p> <p>¹2020 includes potential activities in 2013 through 2020.</p> <p>²2030 includes potential activities in 2021 through 2030 and planning concepts from the 2020 scenarios.</p>		

4.5.1 2020 Scenario

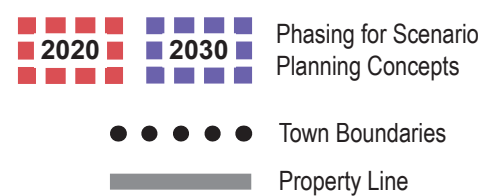
The 2020 planning scenario includes a range of planned and potential airfield facilities, as described below. Future considerations in the Pine Hill and West Airfield are unchanged since the 2005 ESRP. In addition, there have been no changes to the East Ramp access alternatives evaluated in 2005.

4.5.1.1 Terminal Area

GA facilities could be added or replaced in the Terminal Area to support personal, business and/or corporate, and flight training activity in the 2020 scenario, as shown in Figure 4-6.

Landside:

- Landside improvements for the Terminal Area considered in the 2020 scenario include improved access to the Terminal and to existing and new GA facilities. New and replacement surface parking spaces for the public and new GA facilities were anticipated.



Hanscom Field 2012 ESR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Terminal Area

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- Other improvements could include the first phase of the Air & Space Museum for the Massachusetts Aviation Historical Society.
- Civil Air Terminal maintenance and needed repairs and a relocated salt storage enclosure facility could be added within this timeframe.
- A new roadway connection and replacement parking would be made from Hanscom Drive to the GA facilities as part of the ongoing Jet Aviation Hangar Replacement Project.

Airside:

Within the 2020 scenario, Jet Aviation's replacement of Hangar 17 is projected to be completed and under operation. As Figure 4-6 illustrates, a 40,000 sf GA hangar could be accommodated in this area. Apron and ramp improvements would be constructed in connection with the Jet Aviation replacement of Hangar 17.

4.5.1.2 ATCT Apron

Existing facilities around the ATCT include aircraft tie-downs, Massport's airfield maintenance shed, and a restricted-access parking lot. Any improvements proposed in this area must not affect the lines of sight from the ATCT. Figure 4-7 illustrates the potential changes and improvements.

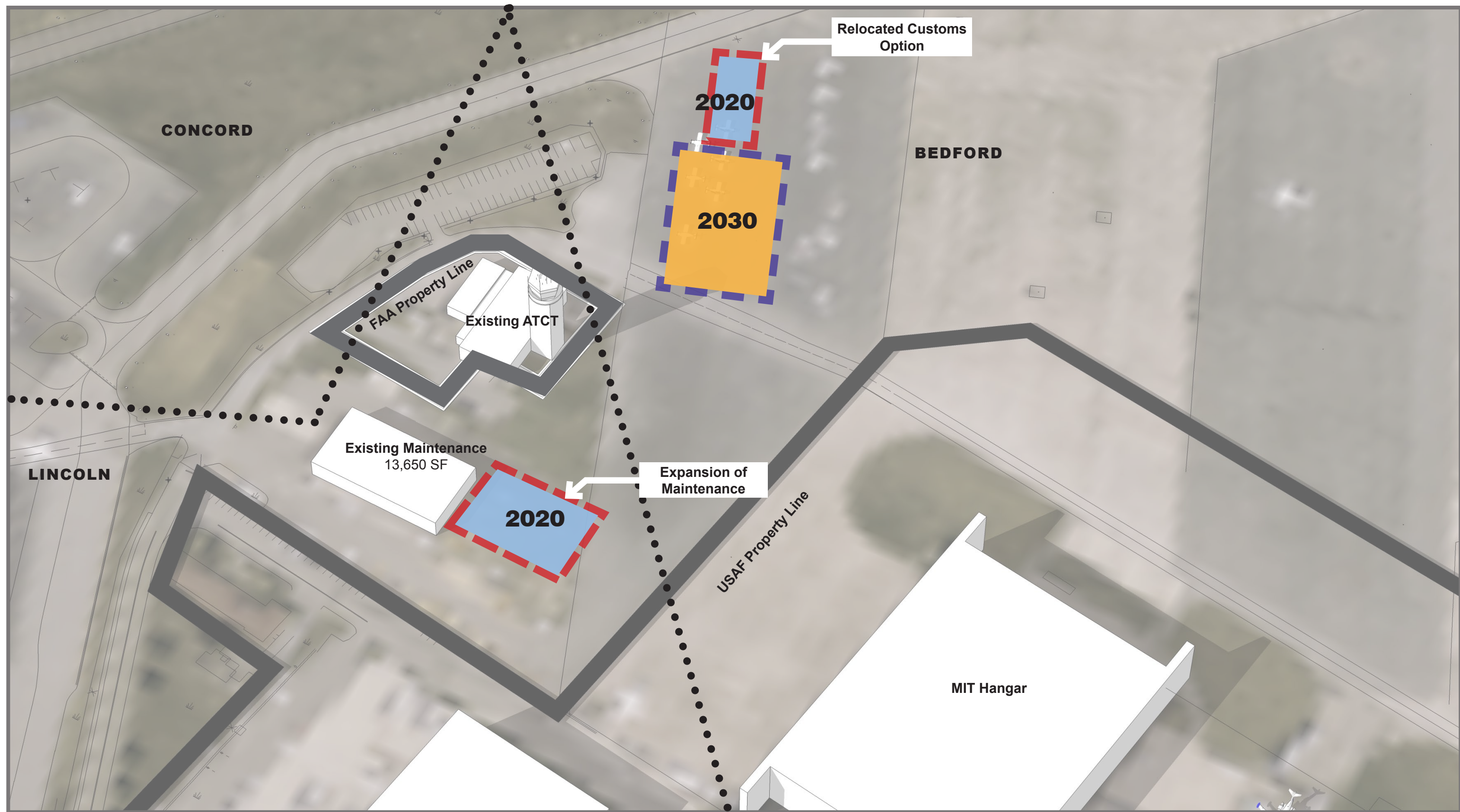
Landside:

Alternative landside access could be developed through the USAF property within the 2020 scenario. This would require planning and coordination with the USAF. The airport maintenance facility is proposed to be expanded within this timeframe.

Airside:

As described earlier, Hanscom's Customs and Border Protection (CBP) facility is located in a trailer along with an adjacent Aircraft Design Group (ADG) V parking position on the East Ramp. The area is suitable for future GA hangar development. One option for relocation of the CBP trailer is to a new facility located at the west end of the East Ramp near the ATCT.

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Hangar Development Parcel

Development Parcel

2020 2030

Phasing for Scenario Planning Concepts

• • • • • Town Boundaries

Property Lines



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

ATCT Apron

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4.5.1.3 East Ramp

Figure 4-8 illustrates the planning concepts for the East Ramp. The East Ramp concept includes expanded and new GA and corporate hangar facilities with full vehicle landside access and one or two potential taxiway connections.

Landside:

On the north side of the East Ramp, the plan identifies a new hangar development area. New hangars could be built in phases, likely starting on the west side and moving east, with roadway access on the north side. Utilities would need to be expanded into the East Ramp upon development of the first hangar on the north side of the East Ramp.

This development could occur on existing impervious surfaces. In 2020, it is assumed that access to the East Ramp would occur by badging and escorting individuals. Massport does not anticipate that this type of development on the East Ramp would trigger MEPA review.

Airside:

In the 2020 planning scenario, the potential for new hangar development on the north side of the East Ramp is calculated as approximately 200,000 sf. The amount of hangar development is determined by market demand from third-party developers. In this development scenario, existing Taxiways B and C, which connect the East Ramp to Taxiway E, may need to be reviewed for possible closure. Two taxiway ingress and egress points (Taxiways A and G) to the new hangars on the north side of the East Ramp would remain. Taxiway A could remain for at least the first phase of development. On the south side of the ramp, the three (36,000 sf, 36,000 sf, and 28,800 sf) existing hangars on the Massport property could be extended by enlarging towards the ramp onto their apron areas. The existing Hangars 2 and 3 could also be rebuilt as a single, expanded hangar of up to 137,000 sf. The height of any hangar development would be restricted to maintain the ATCT line of sight to the airfield movement area and within the tolerances of the FAR Part 77 surfaces from the runways. On the East Ramp, it appears that the ATCT line of sight is more restrictive than the FAR Part 77 surface.

Access to the CBP office needs to be maintained in a manner so that ADG V aircraft can be inspected. As noted above, full development of the East Ramp Area might eventually require relocating the CBP office, and a location closer to the west side of the East Ramp has been identified for this potential relocation.

4.5.1.4 North Airfield

Two parcels of land north of Runway 5-23 in Bedford abut the airfield and have been vacated. The other parcel is owned by Massport, which until 2011 was leased by the USAF, but has since been cleared of structures and returned to Massport. One of these parcels is currently owned by the U.S. Navy, but was used by Raytheon until 2000. Massport expects to acquire the property in 2014.

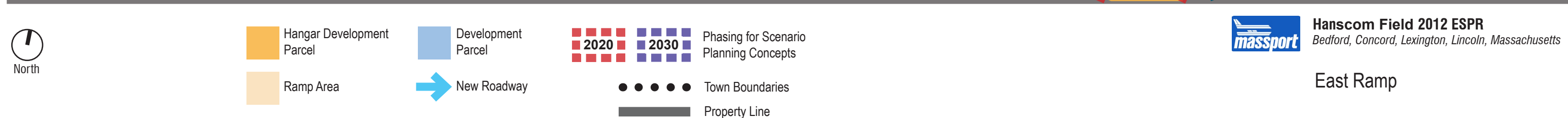
Aviation improvements in the North Airfield evaluated as part of the 2020 scenario include GA facilities, and aircraft and vehicle parking spaces on the formerly leased USAF parcel, as shown in Figure 4-9. Massport has received some interest from third-party developers to use this property. Multiple corporate hangars could be accommodated in this area without affecting wetlands. The area would require leveling in some areas before any hangars could be constructed. This concept will require NEPA review and may trigger MEPA review depending on the extent of the development.

Landside:

Corporate and GA facilities could be constructed with associated parking in the area of existing parking spaces and previous development.

Airside:

Corporate and GA facilities could be constructed with a total program of up to 165,000 sf, together with new ramps and taxi lanes for the GA facilities are proposed in this scenario. The amount of hangar development is contingent upon market forces driving third-party development of GA facilities.



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4.5.2 2030 Scenario

In the 2030 scenario, additional development beyond what was evaluated for 2020 could occur in the Terminal Area, East Ramp, and North Airfield. There are no updates to the Pine Hill and West Airfield and future considerations in these areas are unchanged since the 2005 *ESPR*. In addition, there are no updates to the East Ramp access alternatives evaluated in 2005.

4.5.2.1 Terminal

The 2030 scenarios include the possible GA facilities, which are described for the 2020 scenarios. The Terminal Area also has the potential for additional GA hangars through the redevelopment of existing T hangar area and new GA hangars to the south of Jet Aviation, as shown in Figure 4-6.

Landside:

The 2030 growth scenario includes a second phase of the proposed Air and Space Museum. A moderate-sized hotel could be located west near the intersection of Hanscom Drive and Old Bedford Road. For analysis purposes, the hotel is anticipated to accommodate between 100 and 200 rooms with basic hotel amenities, such as a restaurant and a limited amount of meeting space. Access to the site could be from either Hanscom Drive and/or Old Bedford Road. This type of development was also evaluated in the 1995 GEIR and the 2000 and 2005 *ESPRs*. The hotel would be expected to serve demand generated by Hanscom Field and the general metropolitan Boston market and address specific local needs, such as those generated by visitors to the MMNHP and the future Air and Space Museum. The possible location of the potential hotel site development parcel is illustrated as a development site in Figure 4-6. A hotel project would require NEPA review and may also trigger MEPA depending on the extent of the development.

Additional vehicle parking might be required for the 2030 Scenario based on future operations and passenger levels. An allowance for optional structured parking over or adjacent to the existing Civil Air Terminal parking area is provided in the 2030 Scenario.

Airside:

Figure 4-6 illustrates an aviation development area that could accommodate approximately 60-80,000 sf of GA facilities with associated ramp space and taxi lanes in addition to the development that could occur in the 2020 scenario.

4.5.2.2 Air Traffic Control Tower Apron

The 2030 scenario analysis assumes the addition of a small GA hangar. Figure 4-7 illustrates the scenario for the ATCT Apron.

Landside:

Access to a new GA hangar would be part of this scenario.

Airside:

In the 2030 scenario, the addition of a smaller GA hangar with approximately 15,000 sf is considered that maintains line of sight to the airfield movement area and is within the tolerances of the FAA Part 77 surfaces.

4.5.2.3 East Ramp

Additional GA facilities beyond those described in the 2020 scenario could be developed in the East Ramp. This development could occur on existing impervious surfaces within the aviation development area that is shown in Figure 4-8.

Landside:

The East Ramp currently has restricted access through the primary entrance to the Hanscom AFB at the Vandenberg Gate. Access to the East Ramp is handled under an agreement that is in place with the Base. With the development of the East Ramp, the number of tenants on the East Ramp could increase. In this event, Massport would like to improve the access to the East Ramp. Two options were considered. The first was to develop a secondary access from Hartwell Road to handle the additional flow of traffic. A secondary access that does not require transitioning through the Base would improve the commute time to the East Ramp. The second option was to maintain access via the Vandenberg Gate and add connections from Marrett Street within the Base.

Airside:

In general, airside facilities could consist of a series of GA and/or corporate hangars that expand from the 2020 Scenario increasing hangar space by up to an additional 160,000 sf.

4.5.2.4 North Airfield

Of the two parcels of land north of Runway 5-23 in Bedford that abut the airfield, the potential aviation improvements in the North Airfield Area as part of the 2030 scenario include additional hangars in the areas formerly leased to the USAF, and hangars and aircraft and vehicle parking spaces on the U.S. Navy parcel. This work assumes that Massport will acquire the Navy parcel.

Landside:

Landside access would be from Hartwell Road.

Airside:

Figure 4-9 illustrates an aviation development area that could accommodate up to 150,000 sf, as GA hangar space with associated ramp and parking. These hangars could be located in the area to the north of Taxiway R and would require access to this taxiway.

4.6 Analysis of Future Utilities

This section presents the potential changes in utility demands that would be needed to serve the 2020 and 2030 scenarios. In general, any improvements and new facilities specified in the 2020 and 2030 scenarios would require new connections and upgrades to the existing utility system. In the 2006 *State of Hanscom* report, Massport identified potential capital projects to upgrade its water, stormwater, and electrical utility systems and to provide utility service to the East Ramp. Massport would work with the appropriate public and private utility companies to implement these projects or other potential system upgrades that would be needed to accommodate the demands of the 2020 and 2030 scenarios. As part of the 2020 scenario, Massport will continue to explore third-party development opportunities on the East Ramp. Massport is considering the feasibility of expanding its electric utility system to parts of Hanscom not currently served by that system.

4.6.1 Water Supply and Demand

In the *2005 ESPR*, water demands were estimated for the 2010 and 2020 scenarios. These demands are shown in Table 4-8. This potential future demand is compared with 2005 existing conditions at Hanscom Field. The development scenarios evaluated in the *2012 ESPR* are of a similar nature and size as the proposed improvements in the *2005 ESPR*.

Table 4-8 Potential Water Usage and Wastewater Generation of 2010 and 2020 Scenarios ^a

	Existing (2005) Conditions (gallons per day)	2010 Scenarios from 2005 ESPR (gallons per day)		2020 Scenarios from 2005 ESPR (gallons per day)	
		Moderate Growth	High Growth	Moderate Growth	High Growth
WATER USE					
Total Average Daily Demand	34,800	44,100	48,000	59,200	66,900
Total Maximum Daily Demand ¹	69,600	88,200	96,000	118,400	133,800
WASTEWATER GENERATION					
Total Average Daily Flow ²	27,800	35,300	38,400	47,400	53,500
Total Off-site Average Daily Flow ³	24,400	30,900	33,600	41,400	46,800
Off-site Peak Flow ⁴	54,900	69,500	75,600	93,200	105,300
Increase over 2000 Peak Flows ⁵	29,900	44,500	50,600	68,200	80,300
1. Based on a ratio of maximum day to average day demand of 2.0 in accordance with Metcalf & Eddy report (1992). 2. A wastewater ratio of 0.8 was utilized to develop total wastewater generation (average daily flow). 3. Wastewater flows Wastewater leaving the site is estimated to be 70 percent of water usage (off-site average daily flow). This reflects some on-site septic systems that do not tie into the Massachusetts Water Resources Authority system. 4. Based on Peak to Average flow ratio of 2.25 as utilized in the 2000 ESPR and Metcalf & Eddy report (1992), considering on-site equalization storage. 5. 2000 Peak Flow equals 25,000 gallons per minute as provide in the 2000 ESPR. 6. The potential water usage and wastewater generation are estimates of activity based on planned future developments. The actual water usage and wastewater generation might differ depending on the actual development implemented.					

Source: Metcalf & Eddy, Water System Improvements Study for L.G. Hanscom Field, 1992

Based on existing water uses and available system flow capacity from the Hanscom AFB of 1,500 gallons per minute at 20 pounds per square inch to the site, the existing systems are sized to supply the potable water flows required for each of the future growth scenarios while maintaining adequate pressures. Future fire suppression requirements might necessitate increased water pressure, standby water storage (fire pumps or alternative standby supply tank), or additional supply and pressure from the Hanscom AFB water system that currently supplies the Massport water distribution system. Massport will either incorporate a campus-wide fire protection plan or require each developer to construct a deluge and fire protection system within the individual site. The potential water usage and wastewater generation are estimates of activity based on planned future developments. The actual water usage and wastewater generation might differ depending on the actual development implemented.

4.6.1.1 Sanitary Sewer System

The potential future wastewater generation was estimated in the *2005 ESPR* for the 2010 and 2020 scenarios. The planned improvements in the *2012 ESPR* are of a similar nature and size as the proposed improvements in the *2005 ESPR*. These results are shown on Table 4-8 and are broken down by stage. Potential new facilities in the West Airfield Area would tie into the existing sewer line in South Road. For the other areas, wastewater flows would continue to be discharged to the Hanscom AFB system as described in Chapter 2, Facilities and Infrastructure.

The existing on-site wastewater system is expected to have the capacity to handle the foreseeable future growth scenarios. Off-site systems via the Hanscom AFB appear to have capacity for the 2020 scenario.

For the 2030 scenario, a detailed wastewater study likely be required to determine if there is available capacity off site. If additional capacity is necessary, options could include obtaining additional capacity to discharge to the Massachusetts Water Resources Authority system, mitigating increases through on-site measures such that the peak pumping rate does not exceed the force main capacity, and/or constructing on-site septic systems meeting Title 5 requirements.

4.6.2 Stormwater Management and Drainage System

As projects are developed that increase impervious surfaces, areas of paving could be removed as part of the development project or as a separate project to ensure that there is no gain in impervious surfaces. Between the 2000 and 2005 *ESPR*'s, Massport eliminated approximately 4.4 acres of impervious surfaces at Hanscom Field by removing unused airside pavement. Since the 2005 *ESPR*, no further removal of impervious surface has occurred. Within the 2012 *ESPR*, as indicated in Table 4-9, some of the potential new GA facilities would add new impervious surfaces. It is estimated that the 2020 scenario could add approximately 9.1 acres of new impervious surface. If all development options proceeded, the 2030 scenario could add an additional 16.6 acres of impervious surface. These areas would be offset to the maximum extent practicable.

Table 4-9 Potential Change in Impervious Surface (Acres) in 2020 and 2030 Scenarios

Planning Area	2020 Scenario ¹	2030 Scenario ²
Terminal Area	2.1 acres	7.2 acres
ATCT Area		
Runway 5 Approach Area	-	-
Pine Hill Area	-	-
West Airfield Area	-	-
North Airfield Area	7.0 acres	9.4 acres
East Ramp Area	-	-
Total Potential Increase/(Decrease)	9.1 acres	16.6 acres
1. 2020 includes potential activities in 2013 through 2020.		
2. 2030 includes potential activities in 2021 through 2030 and planning concepts from the 2020 scenario.		

Any new facilities in the 2020 and 2030 scenarios would be required to meet the MassDEP Stormwater Management Standards for water quality and quantity. This would be achieved through the implementation of various stormwater BMPs to mitigate peak runoff rates so that post-development peak runoff rates do not exceed existing conditions. The site's stormwater runoff ultimately outfalls to the Shawsheen River, Elm Brook (both Class B watercourses according to 314 CMR 4.06 Surface Water Quality regulations), and to on-site wetland resource areas. The stormwater runoff would be treated for water quality to achieve a total suspended solids removal rate of 80 percent prior to discharging into these resource areas in accordance with the MassDEP Stormwater Management Standards.

4.6.3 Electrical Distribution System

The on-site distribution system delivers electricity to all of Hanscom Field. According to the evaluation in the 2005 *ESPR*, additional capacity and an expanded distribution system would be necessary to serve the 2010 and 2020 Moderate and High Growth scenarios. Massport has identified potential upgrades to the electrical utility system as part of the 5-year capital program. This additional electrical supply might come from sources other than NSTAR Electric and Gas or CMPL Trading Company. The additional capacity has not been implemented and would still be required if the 2020 and 2030 scenarios were implemented. However, because the level of development considered in the 2010 and 2020 growth scenarios has not yet

materialized due to the economic downturn, improvements are not an issue for operations today but will need to be accomplished to support certain levels of future development.

4.6.4 Natural Gas

According to the *2005 ESPR*, the natural gas distribution system has sufficient capacity to accommodate the 2010 and 2020 Moderate and High-growth scenarios because potential additional future demand was considered when the existing 4-inch high-pressure main line was sized. This condition remains unchanged for the *2012 ESPR*. Massport is currently working with the USAF on a gas line extension that will connect Hangars 1, 2, and 3 to natural gas service. It is anticipated that this extension will be completed in 2014.

4.6.5 Telephone and Communications

According to the *2005 ESPR*, upgrades to telephone and other communications service capacities would be needed to accommodate the 2010 and 2020 Moderate and High Growth scenarios. The upgrades have been ongoing with improvements made in 2012 and 2013.

4.7 Consistency of 2012 ESPR with Plans and Regulations

Massport is a state authority that owns and operates public-use transportation facilities that include Boston-Logan International Airport, Worcester Regional Airport, Hanscom Field, marine terminals within the Port of Boston, and a range of real-estate properties in the Boston area. Massport's goals and objectives are consistent with local plans of the towns of Bedford, Concord, Lexington, and Lincoln and regional plans such as MAPC's *MetroPlan 2000* and *MetroFuture*. Massport supports many of the principles described in these plans, including the creation and operation of environmentally friendly facilities, sustainability, promoting regional equity, economic development opportunities, and the efficient use of existing resources. Massport seeks to achieve these results within the context of managing public-use facilities.

Hanscom Field has existed as an airport in its present location since 1941. After providing primarily military service from 1941-54, Hanscom became a GA airport and control of the airfield's general operations and maintenance was transferred to Massport in 1974. Much of the infrastructure and impervious surfaces of the airfield has remained largely unchanged under Massport's tenure. However, the predominately rural, agricultural character of the area surrounding Hanscom Field continues to be transformed by increasing residential and commercial development independent of and unrelated to Hanscom Field.

Activities at Hanscom Field are consistent with local, regional, and other plans, to the extent that these plans or policies apply to Hanscom Field. The future scenarios described in the *2012 ESPR* are consistent with those that were evaluated in the *2000 and 2005 ESPRs*, but with lower commercial air passenger forecasts. The 2020 and 2030 scenarios describe potential additional aviation and aviation-related uses on the airport and retain many areas in their current, natural state. A hotel use, which is included in the 2030 scenario, is compatible with land uses in the adjacent communities, MMNHP, and Hanscom AFB. Massport has also implemented many of the recommendations of the Hanscom Noise Workgroup.

Hanscom Field continues to have a minimal effect on local traffic, air quality, water quality, and wetland resources. However, Hanscom Field remains an airfield facility and, therefore, has the accompanying effects implicit to aircraft operations, including aircraft noise. Noise analysis and mitigation are discussed in detail in Chapter 7, Noise.

Massport's plans are currently limited to those investments described above in the Five-Year Capital program. These plans support Hanscom Field's role as a premier full-service GA airport with limited commercial passenger service. The future scenarios that were evaluated in this document present estimates of what could happen at Hanscom Field using certain assumptions, not necessarily what will happen. In this context, Massport has identified environmental management approaches to help achieve consistency with the local and regional plans.

4.7.1 Federal and State Regulations

This ESPR identifies potential projects that could occur based on the aviation forecasts described in Chapter 3, Airport Activity Levels. Massport will follow appropriate local, state, and federal review for any future project that triggers such reviews. For example, the 2030 scenario identifies parking demand that could be met by increased surface or structured parking, which may require MEPA and NEPA review. Before proposing changes such as to the parking supply, Massport would review MEPA and NEPA regulations to determine if it needed to file with MEPA and NEPA and, if appropriate, make the necessary environmental filing for the project.

4.7.2 Consistency with the 1978 Master Plan and Massport's 1980 Regulations

Massport's 1978 Master Plan and 1980 regulations for Hanscom have guided Massport's development of the *2012 ESPR*. The *2012 ESPR* reaffirms the role of Hanscom Field as a premier regional GA airport with limited commercial service. The Master Plan anticipated cargo operations at the airport and commercial air passenger services. The *2012 ESPR* evaluates future scenarios that include scheduled commercial passenger service utilizing aircraft of no more than 60 seats, but did not consider cargo services given current market conditions. The number of operations for each future year scenario, including the 2030 scenario, is well below the Master Plan's estimated practical capacity of 320,000 operations per year.

4.7.3 Consistency with Local Plans

In general, the visions articulated by Bedford, Concord, Lexington, and Lincoln and their planning documents speak to a desire to preserve the historical character and natural resources of the towns, while balancing the demands of changing social and economic conditions. Economic development, which has occurred throughout the four towns and the larger suburban area, has resulted in the associated traffic and environmental impacts experienced in the area.

The basic use of Hanscom Field for aviation purposes takes place within a local planning and zoning context that only describes non-aviation related uses. The towns' plans do not provide for aviation related land uses. The Commonwealth's policy is to maintain Hanscom Field as a key aviation resource. While Massport considers local planning and zoning, it is not subject to local regulations unless specified by state law.

4.7.4 Consistency with Regional Plans

The efficient use of Hanscom Field as an existing part of the region's transportation infrastructure is consistent with "Smart Growth" policies, including those outlined in MAPC's *MetroPlan 2000* and *MetroFuture*. In addition, through the ESPR process, Massport has identified and clearly described potential environmental effects of future scenarios to provide a comprehensive evaluation of potential conditions that would be associated with forecasted aviation activity levels.

5 Regional Transportation Context

This chapter reviews the role of Hanscom Field in the region's broader airport and long-distance transportation system. It describes Massport's efforts to work with other state and regional transportation agencies in a cooperative planning context to strengthen the regional transportation network. The chapter also focuses on the regional transportation planning initiatives that Massport is undertaking relative to Hanscom, Worcester, and Logan. Highlights of the chapter include:

- Hanscom's role in the regional airport system;
- The role of Logan Airport in the regional airport system;
- An update on the integration of New England regional airports as a regional system;
- Massport's efforts to promote commercial airline services at Worcester Regional Airport;
- Passenger and aircraft operations at the regional airports in 2012 and trends in aviation activity levels at the regional airports since 2005;
- The status of current improvement plans and projects at the regional airports;
- Long-range cooperative regional transportation planning;
- An update on long-distance rail services including Amtrak's Acela and Northeast Regional services along the Northeast Corridor; and
- Airport ground access improvements.

5.1 Key Findings Since 2005

Hanscom Field is the busiest general aviation airport in the Massachusetts and New England region. Hanscom has historically accommodated a wide variety of general aviation (GA) activities, including business/corporate aviation, light cargo and limited commercial passenger service, air taxi/private charter services, recreational and personal flying, and pilot flight training. In addition to general aviation, Hanscom accommodates some commercial airline services and limited military flights associated with Hanscom AFB. Because of its close proximity to Boston and the Route 128/I95 and Route 495 high-tech corridors, Hanscom accommodates more GA activity than any other GA or commercial service airport in the region (Figure 5-1). Hanscom handles over five times as many general aviation operations as Boston-Logan International Airport and provides substantial airside relief to Logan. While Hanscom has supported limited commercial airline services, its primary roles within the regional airport network are to function as a general aviation reliever for Logan Airport and serve as a premier general aviation facility for the region.



Figure 5-1 General Aviation Reliever and Commercial Airports Accommodating General Aviation Activity in the Greater Boston Metro Area

Hanscom also provides limited commercial passenger service

- General aviation operations in the greater Boston area fell by 3.2 percent per year between 2005 and 2012 as a result of high fuel prices, a weak economy and declining number of student pilots, consistent with the national trend. By comparison, general aviation activity at Hanscom was more stable, falling by only 0.1 percent per year over the same period.
- Passenger levels at the regional airports have declined steeply in recent years, similar to trends at other small regional airports across the nation. From 2005 to 2012, the combined passenger traffic at the regional commercial airports in New England dropped by 29 percent, or 4.7 percent per year. Hanscom lost its only commercial airline service in September 2012 when Streamline Air ceased operations. The passenger declines are a result of reduced airline capacity at the smaller regional airports as airlines cut services on thinner, less profitable routes to deal with high fuel costs and weak passenger demand resulting from the 2008/09 economic crisis and subsequent sluggish economic growth.
- In 2012, Logan's passenger traffic reached a new peak of 29.3 million, which represents 66 percent of the region's commercial air passengers. JetBlue's aggressive expansion and the entry of other low-cost carriers have been the primary drivers of passenger growth at Logan Airport.
- Massport's successful efforts to increase regional airport utilization have led to an increased role for the region's secondary airports in serving air passenger demand. Despite recent declines in passenger traffic at the T.F. Green and Manchester airports, their combined share of the Logan/T.F. Green/Manchester market area has increased from 11 percent in 1995 to 17 percent in 2012.
- Since 2005, commercial operations at Logan and the regional airports have declined by 2.0 percent per year and 6.2 percent per year, respectively. The downward trend in commercial aircraft operations reflects airline reductions in scheduled services, especially at the smaller airports, as well as an industry-wide shift away from small aircraft and tighter capacity control on the part of

airlines. Airlines have retired large numbers of the small regional jets (RJs) with 30 to 50 seats, which have proven to be cost-ineffective in the current high fuel price environment, while increasing the use of large RJs or turboprops with 60 to 90 seats. Commercial operations at Hanscom Field have historically represented less than one percent of the region's total commercial operations.

- Massport, in conjunction with the city of Worcester, has been active in promoting the reintroduction of scheduled airline service at Worcester Regional Airport. JetBlue commenced new services from Worcester to Orlando International and Fort Lauderdale-Hollywood airports on November 7, 2013.

5.2 The Role of Hanscom Field and Logan Airport in the Regional Airport Network

5.2.1 Role of Hanscom Field

Hanscom Field currently serves as a premier full-service general aviation facility for the Massachusetts and New England regions with limited commercial passenger service. The airport accommodates a variety of corporate and private general aviation activities, as well as air taxi/charter, and public service operations that might otherwise use Boston-Logan International Airport. This role for Hanscom Field as a general aviation reliever with limited commercial service was established in the airport's 1978 Master Plan and clarified in Massport's 1980 Regulations.

Hanscom Field does not currently play a significant role in meeting the region's scheduled commercial air travel needs. Shuttle America and Boston-Maine Airways provided limited commercial services from Hanscom in the past, but discontinued services in 2004 and 2008, respectively. Streamline Air initiated regularly scheduled service at Hanscom in April 2011, but suspended operations in September 2012.

The ability of Hanscom Field to provide more significant air passenger services is affected by its proximity to several larger commercial service airports (e.g., Logan, Providence/T.F. Green and Manchester-Boston). The airport is also subject to Massport's 1980 Regulations for Hanscom Field, which restrict scheduled commercial passenger services to aircraft with 60 seats or less.

5.2.2 Role of Logan Airport

By virtue of its location relative to New England's population and commercial center, Logan Airport is the region's dominant airport for scheduled commercial airline services. Logan Airport, the primary commercial airport for the core Boston metropolitan area, serves the long-haul domestic and international air travel needs of the New England region. Logan Airport also provides more than 50 daily departures to small and/or remote communities including the Cape & Islands and markets in northern New England and upstate New York, connecting these communities to the national air transportation network.

5.2.3 Massport's efforts to support a regional airport network

Massport advocates a multi-modal regional transportation policy to improve the efficient use of the region's transportation infrastructure by the appropriate expanded use of regional airports and alternative transportation modes. In response to growing congestion and delays at Logan Airport in the 1990s, Massport adopted a policy to promote increased usage and development of New England's regional airports and to support the region's inter-city rail projects. For nearly two decades, Massport has formed partnerships with federal, state and regional agencies to support an integrated regional transportation plan

that expands and improves inter-city travel options for New England through an integrated, multi-modal regional transportation network.

Massport's efforts to increase regional airport utilization have led to an increased role for the region's secondary airports in serving air passenger demand. The regional airports that are closest to the Boston area and have the greatest influence on passenger traffic and aircraft activity at Logan are Providence/T.F. Green Airport in Warwick RI, Manchester-Boston Regional Airport in Manchester NH, and Worcester Regional Airport. In the late 1990s, Massport's cooperative marketing efforts with the regional airports led airlines, including Southwest Airlines, to initiate new services at T.F. Green and Manchester-Boston airports viewing them as attractive alternatives to Logan, which suffered from airside delays as well as roadway access congestion. An increase in scheduled services and the introduction of competitive airfares at the regional airports resulted in the secondary airports accommodating a higher share of the region's commercial air passengers. As shown in Figure 5-2, T.F. Green and Manchester airports have increased their share of passengers in the combined Logan/T.F. Green/Manchester market area from 11 percent in 1995 to 17 percent in 2012.

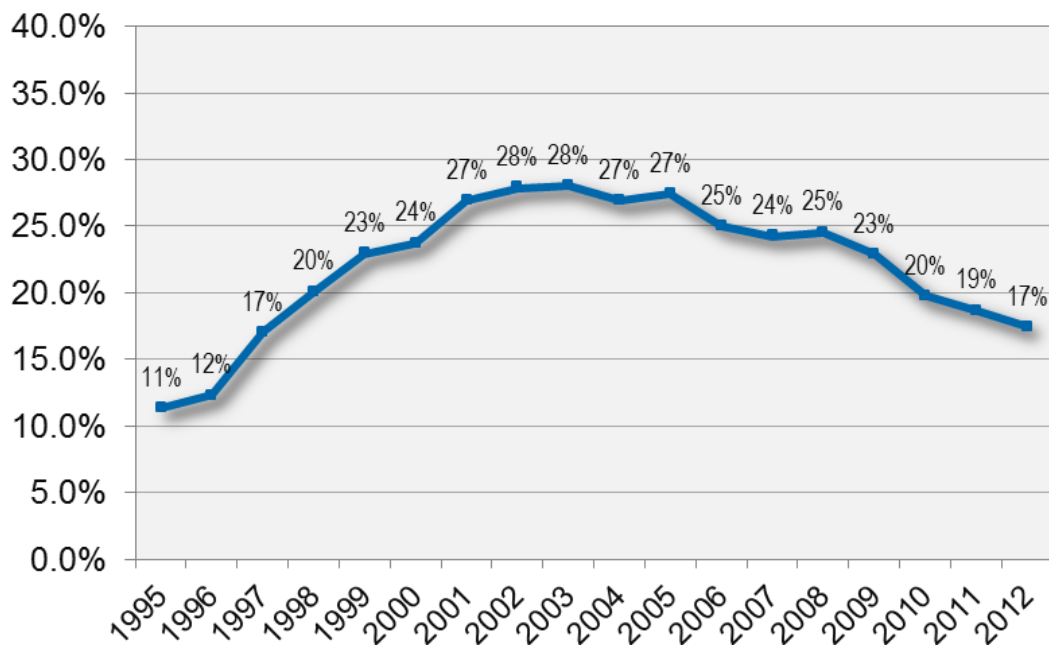


Figure 5-2 T.F. Green and Manchester Share of Boston Area Airport Passengers

Note: Percent represents T.F. Green and Manchester-Boston passengers as a percent of total T.F. Green, Manchester-Boston and Logan Airport passengers.

Source: Individual airport traffic reports.

The T.F. Green and Manchester market share peaked at 28 percent in 2003 as the major elements of the Central Artery/Tunnel projects in Boston were nearing completion. Their market share began to decline with the introduction of low-fare JetBlue services at Logan beginning in 2004. More recently, the regional airports have been negatively affected by airline service cuts stemming from high fuel prices and weak passenger demand following the economic recession and slow recovery. Logan Airport, on the other hand, has benefitted from JetBlue's aggressive expansion at Logan, which is now a key focus city in the JetBlue network with over 100 daily departures. As shown in Figure 5-2, the T.F. Green and Manchester market share declined to approximately 17 percent in 2012. Nevertheless, the airports accommodate a greater share of the region's passengers than they did in the mid-1990s. Massport continues to support regional initiatives and efforts to promote air services at regional airports, including Worcester Regional

Airport. Because of limited capacity at Logan Airport, it is expected that airlines will continue to serve the New England air travel market by offering air services from Logan as well as the outlying regional airports.

Massport has also been active in promoting air service activity at Worcester Regional Airport in Worcester MA. Massport began collaborating with the City of Worcester in 1995 to identify opportunities for increasing Worcester's utilization to accommodate some of the regional demand that would otherwise use Logan Airport. Massport assumed operation of Worcester Regional Airport in 2000 and acquired the airport from the City of Worcester in June 2010. While Worcester has a long history of commercial airline services, it was served only sporadically by Allegiant Airlines and Direct Air, after 2003 when US Airways discontinued services. In April 2012, after a concerted effort by Massport and the local Worcester community to recruit air carriers to the airport, JetBlue announced new services from Worcester to Orlando International and Fort Lauderdale-Hollywood airports. JetBlue began operating one daily roundtrip to each Florida destination November 7, 2013.

5.2.4 Expected Future Role of Hanscom Field

As part of its regional approach, Massport is committed to maintaining Hanscom Field as a vital transportation resource within the regional airport system. Hanscom Field will continue to function within the regional airport network primarily as a general aviation reliever for Logan Airport and as the region's premier, full service general aviation and business aviation airport with limited commercial passenger service.

5.3 Regional General Aviation Activity Trends

Table 5-1 compares general aviation operations for Hanscom Field to other general aviation reliever and commercial service airports in the greater Boston metropolitan area. In 2012, Hanscom handled nearly 165,000 general aviation operations, approximately 32 percent of total general aviation operations in the region. Hanscom remains the busiest general aviation facility in the region and the primary general aviation reliever for Boston-Logan International Airport. Hanscom handled almost six times as many general aviation operations as Boston-Logan International Airport in 2012. Norwood Municipal, the next busiest general aviation airport in the Greater Boston area, handled approximately 68,000 annual general aviation operations, about 59 percent fewer operations than Hanscom.

Overall, general aviation operations in the greater Boston area fell by 3.2 percent per year between 2005 and 2012, consistent with the national trend. General aviation operations at all U.S. towered airports declined by 3.6 percent per year from 2005 to 2012.²⁸ High fuel prices, a weak economy and a decline in the number of student pilots over the past decade have depressed the overall demand for general aviation. An even sharper drop in general aviation operations occurred following the global credit crisis, the 2008/09 economic recession in the U.S. and a reduction in the use of corporate air transportation by many businesses. Over a two-year period from 2007 to 2009, general aviation operations in the U.S. fell by 15.5 percent.²⁹

²⁸ FAA. Aerospace Forecast, FY2013-FY2033

²⁹ Ibid.

Table 5-1 General Aviation Operations at General Aviation Reliever and Commercial Service Airports in the Boston Metropolitan Area

Airport	Primary Aviation Service	General Aviation Operations ¹		Average Annual Growth	Percent Local (2012)	Based Aircraft ² (2012)
		2005	2012			
Hanscom Field	General Aviation	165,424	164,835	-0.1%	42.3%	340
Norwood Municipal	General Aviation	70,496	68,405	-0.4%	51.9%	160
Beverly Municipal	General Aviation	64,110	58,203	-1.4%	54.9%	98
Nashua/Boire Field	General Aviation	127,573	55,620	-11.2%	53.2%	324
Lawrence Municipal	General Aviation	70,828	52,157	-4.3%	45.8%	212
Worcester Regional	General Aviation	65,938	44,070	-5.6%	39.8%	63
Portsmouth International	General Aviation	32,586	38,132	2.3%	67.7%	117
Boston Logan International	Commercial Service	32,652	28,144	-2.1%	0.0%	-
Manchester-Boston	Commercial Service	27,538	12,504	-10.7%	21.8%	60
Total		657,145	522,070	-3.2%	39.8%	1,322
Notes:						
1. Includes air taxi operations except for Manchester-Boston Airport, where air taxi operations counts are comingled with regional commuter airline operations.						
2. Hanscom Field based aircraft are from Massport records. All other based aircraft from FAA, Terminal Area Forecast.						

Sources: Massachusetts Port Authority; Federal Aviation Administration, ATADS; and FAA, Terminal Area Forecast, December 2012.

General aviation activity levels at Hanscom Field have remained relatively stable in recent years. Between 2007 and 2012, general aviation and military operations at Hanscom declined slightly by an average 0.1 percent per year. While Hanscom's current general aviation operations are still substantially lower than previous peak levels (over 204,000 general aviation operations in 2000), the airport has continued to accommodate a very strong level of general aviation demand and has performed well relative to other general aviation reliever airports in the region. With its proximity to Boston, as well as the growing metro-west suburbs and Route 128/I-495-area businesses, Hanscom is expected to continue to be the principal airport for meeting the region's corporate and business aviation needs.

5.4 Regional Commercial Service Trends

The region's air passengers are primarily served by a network of commercial service airports throughout the six-state region. Figure 5-2 depicts the airports that are included in the FAA's New England Regional Airport System Plan. Boston-Logan International Airport, the largest of New England's commercial service airports, served 29.3 million passengers or about 68 percent of the region's air passengers in 2012. The other commercial airports range in size from the Bradley International Airport in Hartford, Connecticut, which served 5.4 million commercial passengers in 2012, to Pease International Tradeport in Portsmouth, New Hampshire, which served 26,820 commercial passengers in 2012.

In addition to its role as a general aviation facility, Hanscom Field has also accommodated limited commercial airline services in the past. Throughout the 1980s, Hanscom received small regional airline services to small commuter markets in New England and up-state New York. After a hiatus during most of the 1990s, commercial airline service was reintroduced at Hanscom in September 1999, when Shuttle America began scheduled services at the airport. Hanscom supported limited regional airline services operated by Shuttle America and Boston-Maine Airways through the beginning of 2008, when scheduled services ceased. In April 2011, Streamline Air launched regularly scheduled flights between Hanscom and Trenton, New Jersey. However, Streamline suspended all services in September 2012 and there is currently no scheduled commercial service at the airport.

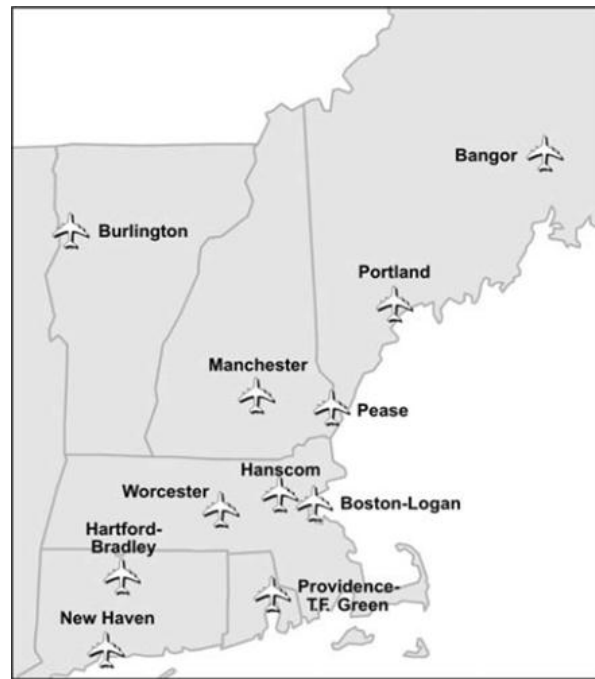


Figure 5-1 New England Commercial Service Airports

5.4.1 Commercial airline trends

The larger regional commercial service airports attracted new low-fare services and experienced strong passenger growth from the late 1990s through 2005. Southwest Airlines expanded into the New England market through the region's secondary airports rather than Logan Airport, introducing service first at T.F. Green (1996) and then at Manchester-Boston (1998) and Hartford-Bradley (1999). As regional airports gained more nonstop service to both origin-destination (O&D) markets and airline connecting hubs, the region became less reliant on Logan Airport for scheduled commercial airline services.

Logan Airport experienced a rapid increase in low cost carrier (LCC) services starting in 2004 when JetBlue entered the Boston market. Since then, JetBlue has grown to be the largest carrier at Logan, accounting for 21 percent of aircraft operations and 25 percent of total passengers in 2012. Other LCC entrants such as Southwest Airlines and Virgin America have also contributed to recent passenger growth at Logan. The expansion of JetBlue and other low-fare services at Logan has contributed to Logan's increased share of regional air passengers.

The challenging airline operating environment has also affected smaller communities disproportionately in recent years. Unprecedented increases in fuel prices over the past decade resulted in steep increases in airline operating costs. Airlines have been forced to eliminate less profitable routes, cut frequencies in smaller markets and reduce flying with small regional jets which are uneconomical to operate at when fuel prices are high. The global economic downturn in 2008 and 2009 further reduced passenger demand and resulted in widespread airline capacity reductions, particularly at the smaller regional airports. While the majority of the service cuts were completed by 2010, airlines have remained conservative with growth plans and have not increased overall capacity significantly at regional airports across the U.S.

5.4.2 Commercial airline passengers

Table 5-2 presents the change in commercial airline passenger levels at Hanscom, Logan Airport and other New England commercial airports between 2005 and 2012. Over this period, combined passenger

traffic at the smaller regional airports declined at an average rate of 4.7 percent per year compared to Logan, where passenger traffic increased by 1.1 percent per year. Passenger levels at Hanscom fluctuated as carriers exited and entered the market. Hanscom's commercial passenger traffic in 2012, when Streamline Air ceased services, was more than 50 percent lower than the passenger traffic accommodated in 2005.

Logan's passenger traffic fell between 2007 and 2010 due to weakening passenger demand during the economic recession and airline consolidation, but has since recovered and reached a new peak in 2012. Passenger growth at Logan was driven primarily by the aggressive expansion of JetBlue and other LCCs at the airport. In 2012, Logan's passenger traffic reached a new peak of 29.3 million and represented 66 percent of the region's air passengers.

Passenger levels at the regional airports have declined steeply in recent years, similar to trends at other small regional airports across the nation. From 2005 to 2012, the combined passenger traffic at T.F. Green and Manchester-Boston airports fell by 39 percent. Total passenger traffic at the regional airports in New England dropped by 29 percent, or 4.7 percent per year. The passenger declines are a result of reduced airline capacity at the smaller regional airports as airlines cut services on thinner, less profitable routes to deal with high fuel costs and weak passenger demand.

Table 5-2 Passenger Activity at Logan Airport, Hanscom Field, and Other New England Commercial Service Airports

Airport	Passengers (millions)		Average Annual Growth	2012 Passenger Share
	2005	2012	2005 - 2012	
Logan Airport	27.09	29.33	1.1%	66.3%
Regional Airports				
Bradley International, CT	7.38	5.38	-4.4%	12.2%
T.F. Green, RI	5.73	3.65	-6.2%	8.2%
Manchester-Boston, NH	4.33	2.45	-7.8%	5.5%
Portland International Jetport, ME	1.46	1.62	1.5%	3.7%
Burlington International, VT	1.38	1.23	-1.6%	2.8%
Bangor International, ME	0.48	0.46	-0.6%	1.0%
Tweed New Haven, CT	0.13	0.08	-7.4%	0.2%
Worcester Regional, MA	-	0.03	-	0.1%
Portsmouth International, NH	0.01	0.03	12.1%	0.1%
Hanscom Field, MA	0.02	0.01	-9.6%	0.0%
Subtotal Regional Airports	20.92	14.93	-4.7%	33.7%
Total New England Airports	48.01	44.26	-1.2%	100.0%

Sources: Massachusetts Port Authority and individual airport data

5.4.3 Commercial airline operations

Commercial airline aircraft operations for Hanscom, Logan and the regional airports for 2005 and 2012 are shown in Table 5-3. Logan Airport, the busiest airport in the region for commercial airline service, handled over 326,700 commercial airline operations or 55 percent of the region's commercial operations in 2012. The regional airports combined accounted for approximately 263,400 commercial operations in 2012, representing 45 percent of commercial operations in the region.

Commercial operations declined at both Logan Airport and the regional airports between 2005 and 2012. This trend reflects reductions in scheduled services, especially at the smaller airports, as well as an

industry-wide shift away from small aircraft and tighter capacity control on the part of airlines. Airlines have retired large numbers of the small regional jets (RJs) with 30 to 50 seats, which have proven to be cost-ineffective in the current high fuel price environment, while increasing the use of large RJs or turboprops with 60 to 90 seats. This ongoing emphasis on restrained capacity growth and larger, more fuel-efficient aircraft has led to increased passenger load factors and a drop in commercial operations across the industry. Since 2005, commercial operations at Logan and the regional airports have declined by 2.0 percent per year and 6.2 percent per year, respectively. Nationwide, commercial airline operations (including regional commuter carriers) declined by 2.8 percent annually over the same period.

Commercial operations at Hanscom Field have historically represented less than one percent of the region's total commercial operations. In 2005, Boston Maine Airways conducted approximately 3,600 aircraft operations at Hanscom. In 2012, Streamline Air performed 635 aircraft operations before suspending services in September 2012.

Table 5-3 Commercial Aircraft Operations at Logan Airport, Hanscom Field, and Other New England Commercial Service Airports

Airport	Commercial Airline Operations ¹		Average Annual Growth	Percent of Total
	2005	2012		
Logan Airport	376,414	326,755	-2.0%	55.4%
Regional Airports				
Bradley International, CT	119,048	79,503	-5.6%	13.5%
T.F. Green, RI	89,489	50,301	-7.9%	8.5%
Manchester-Boston, NH	76,115	45,379	-7.1%	7.7%
Portland International Jetport, ME	42,661	33,118	-3.6%	5.6%
Burlington International, VT	43,987	27,067	-6.7%	4.6%
Bangor International, ME	25,924	16,128	-6.6%	2.7%
Portsmouth International, NH	2,303	5,722	13.9%	1.0%
Tweed New Haven, CT	6,137	3,936	-6.1%	0.7%
Worcester Regional, MA	2,727	1,639	-7.0%	0.3%
Hanscom Field, MA	3,627	635	-22.0%	0.1%
Subtotal Regional Airports	412,018	263,428	-6.2%	44.6%
Total New England Airports	788,432	590,183	-4.1%	100.0%
Notes:				
1. May include some air taxi operations at airports other than Logan, Hanscom and Worcester.				

Sources: Massachusetts Port Authority; Federal Aviation Administration, ATADS and Terminal Area Forecasts

5.5 Regional Airport Improvement Plans and Projects

The following section describes airport improvement projects being planned or underway at the regional airports.

5.5.1 Hanscom Field, Bedford, MA

Massport continues to invest in Hanscom Field to improve and upgrade facilities and maintain a safe, secure and efficient airport. Past and future capital investments ensure that Hanscom can continue to serve its role as a general aviation reliever to Logan with limited commercial passenger service and premiere business aviation facility for the region. In FY 2012, Massport invested \$3.4 million in airfield, terminal, equipment and other facility improvements at Hanscom. These airport improvement projects

are summarized here and described in more detail in Chapter 4, Airport Planning, as well as in the annual report on *The State of Hanscom*.

Massport's FY 2012 capital investment projects at Hanscom included:

- Relocating portions of the perimeter road at the approach to Runway 11 to comply with FAA Runway Safety Area mandates.
- Maintenance of vegetation removal areas and the trail system that connects two Massport-owned parcels with portions of conservation land and open spaces in the towns of Bedford and Concord. In addition, Massport performed aerial photogrammetric mapping as part of its five-year Vegetation Management Plan update.
- Implementation of an enhanced Access Control System in conjunction with the replacement of a portion of the perimeter fence which had reached the end of its useful life.
- Signage and landscape improvements along the airport entrance.

Planned projects for FY 2013 and beyond include:

- Relocation of portions of the perimeter road at the approach to Runway 29 to comply with FAA Runway Safety Area mandates.
- Rehabilitation of pavement areas along the entry roadway.
- Airfield pavement replacement will continue to be an ongoing project in coming years.

In addition to Massport's investments, the Authority solicits third-party development of facilities that support and enhance Hanscom's role in the regional transportation system. Many of the hangars at Hanscom are owned or leased by tenants who are responsible for maintaining them.

On-going third-party projects at Hanscom include the following:

- In 2012, Rectrix Aviation was selected by Massport to develop FBO facilities at the former Hangar 24 site at Hanscom Field and also at the Worcester Regional Airport. Demolition of the Hangar 24 was completed in September 2012 and Rectrix began construction of the new hangar and FBO facilities at both airports in 2013. Project completion for the new FBO facilities at both airports is expected by early 2014.
- The Massport Board approved a proposal by Jet Aviation, a current FBO operator at Hanscom, to replace Hangar 17 with a more modern facility. In 2012, Jet Aviation initiated the planning and design process and permitting is underway as of the date of this document.

5.5.2 T.F. Green/Providence, Warwick, RI

In September 2011, the FAA issued a favorable Record of Decision (ROD) approving the Preferred Alternative for the T.F. Green Airfield Improvement Program, which will allow an extension to the airport's main runway to allow for nonstop flights to the West Coast. In January 2013, the FAA issued a final Written Reevaluation of the ROD, as project design and construction phasing has changed since the ROD was issued. Construction of project elements of the T.F. Green Airfield Improvement Program began in July 2013 and is expected to continue through December 2017. The Airfield Improvement Program includes the following projects:

- Phase 1 of the Runway 16 End Safety Area Improvements project will be completed by the end of 2013. Phase 1 involves preparation of the site of the Engineered Material Arresting System (EMAS), airfield electrical improvements on the Runway 16 end and reconfiguration of the taxi lane from the northeast ramp to the Runway 16 end.

- Phase 2 of the Runway 16 End Safety Area Improvements project, which involves installation of the EMAS, will begin in May 2014 and is expected to be completed in June 2014.
- The demolition of Hanger 1 will also be completed by the end of 2013. In addition to the hangar removal, this project involves the construction of an aircraft parking apron in a portion of the former hangar's footprint.
- Construction of a Deicer Management System, which will collect and treat the glycol used to de-ice aircraft at T.F. Green, will begin in the spring of 2013. The system is expected to be operational by the end of 2015.
- The Runway 34 End Safety Area Improvements project will commence in May 2014. Major elements of the project include the reconstruction of 1,600 feet of Runway 16-34, EMAS construction at the Runway 34 end, partial reconstruction of Taxiway C, installation of new edge lights on taxiway C, and construction of the associated airport service road.
- FAA System Upgrades, which will proceed concurrently with the Runway 34 Safety Area Improvement project, will include improvements to the approach lighting system and Glide Slope Antenna.
- The Runway 5 End Extension project is expected to begin in 2016 and be completed by the end of 2017. This project involves extension of the Runway from its current length of 7,166 feet to 8,700 feet, which will allow T.F. Green to handle aircraft capable of long haul flights to West Coast destinations. The project also involves an extension of the parallel Taxiway M and construction of an EMAS at the Runway 5 end.

5.5.3 Manchester-Boston Airport, Manchester, NH

Since the early 1990s, over \$500 million was invested in Manchester-Boston Airport to improve and develop landside and airside facilities and infrastructure. Projects included a 158,000 square foot passenger terminal and two subsequent 75,000 square foot terminal additions, a 4,800 space parking garage with an elevated pedestrian walkway connection to the terminal, roadway improvements and extensive runway reconstruction and lengthening. Recent customer service enhancement initiatives have included the construction of a new cell phone lot in 2007 for motorists waiting to pick up passengers and various concessions improvements through 2008 and 2009.

Manchester-Boston Regional Airport completed an Airport Master Plan Update in 2011. The master plan update provides a blueprint for development and improvement of airport facilities and infrastructure through 2030. Recent and on-going improvement projects at the airport include:

- The Terminal Ramp Replacement Project to rehabilitate the concrete apron areas adjacent to the terminal building began in 2012 and is anticipated to be completed in 2013.
- Demolition of structures in the runway protection zone (RPZ) of Runway 06 involves the removal of buildings with usages deemed non-compatible with RPZs as defined by the FAA. Elements of the project include the demolition of the Highlander Inn and Conference Center and associated buildings.
- Upgrades to the terminal building HVAC systems will address certain deficiencies in the terminal cooling system and will provide significant improvements to customer comfort levels within areas of the terminal building.

Other potential projects over the coming years include:

- Roadway and parking improvements;

- Curbside enhancements;
- Refurbishing and expansion of baggage claim equipment;
- Construction of a glycol collection/treatment facility; and
- Construction of a snow removal equipment storage building.

5.5.4 Bradley International Airport, Hartford, CT

A \$200 million airport modernization project at Bradley International Airport was completed in 2010. Originally launched in 2000, the modernization project introduced a refurbished and expanded Terminal A with an additional 260,000 square feet of new concourse, ticket counters and waiting areas, major gate renovations, and a state-of-the-art security and communications system. A 28,000 square feet International Arrivals Building was also completed.

In 2011, the Connecticut Airport Authority (CAA) was established to oversee the operation and development of Bradley International Airport. The CAA, a quasi-public agency consisting of an 11-member board, will manage day-to-day operations at Bradley International Airport, as well as at five GA airports in Connecticut. The goal of the CAA is to transform Bradley International Airport and the state's five GA airports (Danielson, Groton/New London, Hartford Brainard, Waterbury-Oxford, and Windham airports) into economic drivers for the state. Bradley International Airport was previously run by a board under the Connecticut Department of Transportation.

A three-year renovation project for the airport hotel, the Sheraton Bradley Airport Hotel, was completed in 2011, featuring newly outfitted guest rooms, a redesigned lobby, and an expanded fitness center and pool. The 2010-2013 Bradley International Airport Strategic Plan highlights several airport improvement projects between 2012 and 2013. These projects include:

- A sound insulation program;
- The rehabilitation of Taxiway C North;
- The rehabilitation of Taxiway C South;
- Utility relocation and obstruction removal;
- The demolition of old Murphy Terminals and design of new Terminal B; and
- Construct roadway realignment.

The airport's \$280 million capital improvement program for FY 2014 –FY 2018 includes the following projects:

- A consolidated rental car facility;
- Demolition of the Murphy Terminal;
- Roadway demolition and re-alignment;
- Utility relocation; and
- Airfield improvements.

5.5.5 Worcester Regional Airport, Worcester, MA

The Worcester Regional Airport Master Plan Update, completed in 2008, was funded by the FAA and the former Massachusetts Aeronautics Commission (MAC). The Worcester Master Plan provides a strategic guide to airport development through 2020. Near-term projects were focused on maintaining essential operations, safety and security functions and included runway pavement reconstruction, runway safety area upgrades, and a vegetation removal and maintenance plan. Long-term initiatives include upgraded corporate/GA facilities including a FBO facility and hangars, a new Airport Rescue and Firefighting

Facility (ARFF) and ongoing runway and taxiway pavement rehabilitation. Various demand driven projects including terminal enhancements and additional parking facilities were also identified; however, these projects depend on the level and type of future aviation activity realized at Worcester Regional Airport. Massport is currently pursuing enhancements to Worcester's all-weather capability including upgrading the Runway 11 Instrument Landing Systems (ILS) from a Category I to a Category III system, and its associated required infrastructure and navigation aids along with a partial parallel taxiway. This project is a safety and operational priority for the Airport.

The following near-term projects identified in the Worcester Master Plan were completed as of 2011:

- Installed engineered materials arresting system (EMAS) on the Runway 29 End;
- Resurfaced 3,000 feet of Runway 11;
- Installed EMAS on the Runway 11 End; and
- Resurfaced 4,000 feet of Runway 29 and reconstructed Taxiway Delta.

In January 2012, Massport approved a proposal by Rectrix Aviation to develop an aircraft hangar and office space at Worcester Regional Airport as part of a joint solicitation for new FBO facilities at Worcester and Hanscom. Construction started on the \$6.7 million project in August 2013. The Rectrix project includes 27,000-square-feet of hangar and office space that will house large corporate jets and a regional aircraft maintenance facility. Rectrix will offer private jet charters and FBO services, including transient aircraft parking and fueling services from the new hangar facility.

Massport has committed to invest in the following additional airside and landside improvement projects over the next few years:

- Installation of a new terminal roof and HVAC system;
- Airside and landside pavement rehabilitation;
- Rehabilitation of the existing ARFF station;
- Security improvements;
- Obstruction removal; and
- Category III ILS upgrade and related taxiway improvements.

5.6 Long-Range Regional Transportation Planning

This section reports on state and regional planning efforts to achieve a balanced regional intermodal transportation network to reduce reliance on Logan Airport and provide travelers with a greater range of long-distance, intercity transportation options.

The unified MassDOT brought together many Commonwealth entities which plan, build, own, operate and maintain all modes of transportation, under a five-member board of directors. (Massport remains an independent authority focused on airport and seaport needs with its own board of directors, including the Secretary of MassDOT.) The creation of MassDOT was intended to help integrate, coordinate and prioritize multimodal transportation policy and investment in Massachusetts, resulting in a more effective, efficient, equitable, rational and innovative transportation system. In 2012, MassDOT continued to make strides in improving the existing transportation infrastructure by addressing structurally deficient infrastructure with innovative construction techniques, developing a comprehensive environmental responsibility and sustainability initiative and continuing to invest in the Boston metropolitan area's rapid transit.

As a fundamental part of the transportation framework in the Boston metropolitan area, and for all of New England, Massport supports an integrated multimodal transportation policy to improve the efficient use of transportation infrastructure on both a metropolitan and a regional scale.

5.6.1 Regional Aviation Economic Impact Study

The Aeronautics Division of MassDOT completed a wide-ranging economic impact study of the statewide airports system's (the 39 public use airports including Logan Airport) contribution to the economy of Massachusetts. The analysis found that Massachusetts public use airports generated \$11.9 billion in total economic activity, including \$4.9 billion in total annual payroll resulting from 124,369 jobs that can be traced to the aviation industry. In particular, Massport's three airports are noted to make significant contributions to the regional economy generating approximately \$10.3 billion or 87 percent of the overall economic benefits generated by the Massachusetts airport system. Specifically, Logan Airport supported over 94,000 jobs in Massachusetts and the total economic impact is now estimated at approximately \$8.87 billion per year and Worcester Regional Airport supported 418 jobs with a total economic impact of \$51.5 million. Hanscom Field is particularly important for its function as the airfield for Hanscom Air Force Base, an active military facility, which is aided by its proximity to Boston-area technology and research industry. Hanscom Field alone supports 1,551 jobs and generates 249 million in economic activity, but combined with Hanscom AFB they together support 11,765 jobs and have a total economic impact of \$1.4 billion. For every \$100 spent by aviation-related businesses, an additional multiplier impact of \$56 is created within Massachusetts according to the study. While the economic impact of the region's airports was the focus of the study, it also noted qualitative benefits of the state's airports including:

- Facilitating emergency medical transport;
- Providing police support;
- Supporting aerial surveying, photography, and inspection operations;
- Conducting search-and-rescue operations;
- Supporting the U.S. military and other government operations; and
- Providing youth outreach activities.

5.6.2 Massachusetts Statewide Airport System Plan (MSASP)

The MassDOT Aeronautics Division (formerly the Massachusetts Aeronautics Commission or MAC) completed the Massachusetts Statewide Airport System Plan (MSASP) in 2010. The MSASP provides guidance to state policy makers for the long term development of the Commonwealth's airport system. It documents the status of the current airport system; provides a long term vision for the system; identifies system goals and related improvements; establishes priorities for system and airport funding; and provides supporting data and materials.

5.6.3 Boston Region Long-term Transportation Vision

Massport is a member of the Boston Region Metropolitan Planning Organization (MPO). The Boston MPO developed a long-range vision for the region and its transportation network out to the year 2035. The vision described by the Boston MPO identifies the Boston metropolitan region as continuing to be an economic, educational and cultural hub that will continue to contribute to a high quality of life. The high quality of life will be supported by a well-maintained transportation system consisting of safe, healthy, efficient and varied options. The variety of transportation options will allow people to find jobs and

services within easy reach of affordable housing, and will reduce environmental impacts thereby improving air and environmental quality. This vision is possible through attentive maintenance, cost-effective management and strategic investment in the region's transportation system. The Long Range Transportation Plan recognizes that Hanscom support air transport of light cargo.

5.6.4 Statewide Long-term Transportation Vision

MassDOT is currently undertaking the Commonwealth's first statewide strategic multi-modal transportation plan known as weMove Massachusetts. weMove Massachusetts' purpose is to inform MassDOT's choices as to how to invest the agency's limited resources. The goals of weMove Massachusetts is to engage stakeholders through a bottom-up approach as well as internal agency stakeholders in a discussion about the present and future needs of the transportation system, to build action-oriented policies based on stakeholder feedback that can serve as a bridge between MassDOT's values and investments, and to develop a forward thinking, data-driven, decision-making methodology to assist MassDOT in implementing its priorities transparently and measurably.

Massport was an active participant in the development of the MassDOT's Rail Plan and Freight Plan. The Massachusetts State Rail Plan is the Commonwealth's 20-year plan for the state's rail system (through 2030) and describes a set of strategies and initiatives aimed at enhancing rail transportation so that it can effectively fulfill its critical role in the state's multimodal transportation network. MassDOT's vision for passenger and freight service is to "develop an efficient intercity passenger and freight rail system that is the logical mode of choice for travelers and shippers, connects travelers and businesses to the national and global transportation network, encourages sustainable economic growth throughout the state, and enables Massachusetts to compete in the rapidly changing global economy." The plan describes recent improvements to extend the MBTA to T.F. Green Airport, the opportunity of high speed rail service in reducing air traffic congestion, and need for connecting rail to Worcester Regional Airport. The Freight Plan describes the important role that Logan and Worcester play is the air transport of freight and important connections with highway and railway networks.

Massport has a representative on the weMove Massachusetts Stakeholder Advisory Group.

5.7.5 New England Regional Airport System Plan (NERASP)

In fall of 2006, the FAA New England Region, in concert with the New England Airport Directors and New England State Aviation Directors, completed the NERASP. The results of this study describe the foundation of a regional strategy for the air carrier airport system to support the needs of air passengers through 2020. To date, the development of that strategy has been instrumental in facilitating the investment and development of the primary commercial airport system in New England.

The New England state aviation officials, in partnership with the FAA, are currently conducting a study of the GA airport system in New England, including primary commercial service airports that service a GA component. During preparation of the 2006 NERASP study which analyzed the primary commercial airports in New England, the group recognized that a similar evaluation of GA would also prove useful. It would provide state aviation officials with a greater understanding of airport roles and infrastructure investment. Faced with the current struggling economy, rising airport and aircraft operational costs, declining operational activity, an aging infrastructure and with limited state and federal funds to address improvements, the importance of developing both a short-range and long-range perspective on the future performance of the New England GA airport system is clear.

This assessment of the New England GA airport system will provide state aviation officials with a common understanding of their state airport system in relation to the New England region as a whole. Assisted by this information, the FAA will be better positioned to make decisions regarding priority capital investments. Moreover, the NERASP study proved that the geographic boundary of the New England region, as well as its cultural identity, makes an overall study of New England an effective planning approach. Information on the NERASP GA study can be found at <http://www.nerasp-ga.com>.

5.6.5 Conference of New England Governors and Eastern Canadian Premiers

The Conference of New England Governors and Eastern Canadian Premiers (NEG/ECP) is a formally established body which coordinates regional policy programs in the areas of economic development, transportation, environment, energy and health, among others. The NEG/ECP focuses on aviation and intercity passenger rail, particularly in the northeastern coastal mega-region, as part of a larger transportation system that needs modal balance. Efficient use of this multi-state network affects the overall viability of the highway, aviation, freight and commuter rail transportation networks that serve the region and the nation. Improved planning coordination between airports and intercity passenger rail services and related ground transportation offers the potential to achieve complementary investments in airport and rail capacity and services. MassDOT has a representative on the NEG/ECP Transportation and Air Quality Committee which covers regional transportation issues and infrastructure development, use, and efficiency. The NEG/ECP and other policy decision makers throughout the region have been able to utilize strategies and information developed in the NERASP, which provides a framework for integrated regional aviation policy and planning. This organization serves an important function to help achieve a greater balance between air, rail and auto trips, and ultimately help to increase overall transportation capacity without overburdening Logan Airport and the New England aviation system.

In 2011, the NEG/ECP passed a resolution on transportation which provided direction on enhancing alternative-fuel vehicle infrastructure in the region, increasing multi-modal transportation options, and improving freight and passenger rail networks.

In August 2012, the New England Governors' Conference, Inc. was absorbed into the Coalition of Northeastern Governors (CONEG). The CONEG recognizes the unique characteristics of the Northeast's transportation system and focuses its priority transportation initiatives on the region's intercity and commuter passenger rail systems and surface transportation network.

5.7 Regional Rail Transportation

This section reports on recent developments and current long-distance rail service originating in Boston, the status of air-rail linkages in the Northeast Corridor, and the expanding Pilgrim Partnership which provides commuter rail between Massachusetts and Rhode Island.

5.7.1 Amtrak Northeast Corridor High-Speed Rail

Amtrak's Northeast Corridor (NEC) is an intercity rail line that operates between Boston-South Station and Washington, DC via New York City. Other major destinations served by the route include Providence, RI; New Haven, CT; Philadelphia, PA; and Baltimore, MD. Logan Airport passengers can connect directly to Boston-South Station via Silver Line bus rapid transit (BRT) service or via taxi. Amtrak operates two services between Boston and Washington, DC: the Acela Express (high-speed, limited-stop service) and the Northeast Regional (lower-speed service that makes local stops along the

route). Travel times on the Acela Express range from 3.5 hours from Boston to New York to just over 6.5 hours from Boston to Washington, DC. Travel times on the Northeast Regional range from about 4.25 hours from Boston to New York to approximately 7.75 hours from Boston to Washington, DC. A total of 19 daily departures are offered from Boston-South Station to Penn Station in New York, of which about half are Acela Express. Most trains continue south to Washington, DC, and a smaller number of Northeast Regional trains continue further south to Newport News, VA.

System-wide Amtrak ridership was 31.2 million one-way trips in Fiscal Year 2012. The NEC represented 37 percent of total system-wide Amtrak ridership. In Fiscal Year 2012, the NEC carried 11.4 million passengers, an increase of 4.8 percent over FY 2011. Acela Express accounted for nearly 3.4 million passengers, while the Northeast Regional accounted for 8.0 million passengers. Overall NEC ridership reached a new record in 2012, surpassing the previous 2011 peak of 10.9 million passengers. Amtrak's share of the Northeast total passenger market has increased substantially since the introduction of Acela service in 2000. Amtrak captures approximately 54 percent of the total air/rail market between Boston and New York, up from 20 percent in 2000, before the introduction of Acela. Several developments and trends have contributed to Amtrak's ridership growth including the introduction of passenger conveniences such as Wi-Fi and eTicketing, high gas prices, overall growth in business travel in the NEC, the growing appeal and acceptance of rail travel, and traveler frustration with increasing highway congestion and the hassles of airline travel.

5.7.2 Northeast Corridor Infrastructure Master Plan and Next-Generation High Speed Rail Plan

The *Northeast Corridor Infrastructure Master Plan*, a new regional rail planning study, was released in May 2010. The Master Plan documents NEC growth needs through 2030, including expanded capacity and improvements in Boston-New York and New York-Washington intercity travel times. A 76 percent increase in rail ridership from 13 million to 23 million, a 36 percent increase in train movements from 154 to 210 average weekday, and the need for \$52 billion in additional capital investment is expected over the next 20 years.

Following up on the release of the *Northeast Corridor Infrastructure Master Plan*, Amtrak also unveiled a Next-Generation High-Speed Rail proposal in September 2010 titled *A Vision for High-Speed Rail in the Northeast Corridor*. The proposal outlines a brand-new 426-mile two-track corridor running from Boston to Washington, offering high-speed rail service with sustained maximum speeds of 220 mph. The route would allow for an 84 minute trip time between Boston and New York and a three-hour trip time between Boston and Washington. Under this Next-Generation high speed rail plan, the New York City – Boston market would see a further shift from auto and air to rail due to the dramatic improvements in rail travel times, and projects the air market between the two city-pairs to be nearly eliminated by 2050. This plan states that the traveler shift to high speed rail would reduce delays on competing modes (air and auto) and the shift away from shorter and smaller intraregional flights would free up air transport capacity for higher-value transcontinental and international flights.

An update to the *Northeast Corridor Infrastructure Master Plan* and *A Vision for High-Speed Rail in the Northeast Corridor* was released in July 2012. Since these two documents were released, the two programs have been integrated into a single, coherent service and investment program, called the Northeast Corridor Capital Investment Program. The Northeast Corridor Capital Investment Program would advance the near-term projects outlined in the Master Plan to benefit the NEC while incrementally phasing improvements to the Acela high-speed service to support the next-generation high-speed rail

proposed. The near-term NEC improvements are identified to occur between 2012 and 2025 and the long-term Next-Generation High-Speed Rail improvements are identified to occur between 2025 and 2040. The publication of the 2012 update is the first step in “improving the NEC for all users in order to sustainably support the population and economic growth facing the Northeast over the next 30 years” but considerable more planning work is required by all stakeholders.

In 2011, the U.S. DOT awarded Amtrak and the New York State DOT \$745 million for two high-speed rail projects on the Northeast Corridor. A major upgrade to tracks and overhead wires will be conducted along a 24-mile stretch in New Jersey, allowing for an improvement in Acela express train speeds from 135 mph today to 160 mph. Improvements to the Harold railroad interlocking in Queens, NY will also be completed, eliminating delays and reducing commuting time for Amtrak riders.

5.7.3 Boston-South Station Expansion

In support of the Northeast Corridor Capital Investment Program, MassDOT is designing and planning the expansion of the Boston-South Station to meet the infrastructure and capacity needs of the NEC. At present, South Station operates above its design capacity for efficient train operations and orderly passenger queuing. Operating with only 13 tracks, the current South Station constrains the current and future rail mobility within Massachusetts and through New England and the NEC. The proposed expansion of South Station will result in the following benefits to rail mobility:

- Improve the performance of existing and future high-speed and intercity passenger rail service to and from Boston. Today’s NEC on-time performance is approximately 85 percent for Acela Express and 75 percent for Northeast Regional trains. The 2030 target for on-time performance is 95 percent for Acela Express and 90 percent for Northeast Regional. Without expanding South Station and its support facilities, not only will these targets be missed, but on-time performance will deteriorate even further in the future.
- Enable growth in high-speed and other intercity passenger rail service in the northeastern U.S., at a time when both the roadway and aviation networks are at or over capacity.
- Support sustainable economic growth and improved quality of life in NEC metropolitan areas, including Boston.
- Support a more attractive and increased MBTA Commuter Rail service, with associated benefits such as increased statewide transportation access, environmental sustainability, and improved personal mobility.

In order for the South Station expansion to move forward, the U.S. Postal Service Distribution Facility located adjacent to South Station must be relocated. Massport is working with MassDOT in evaluating suitable locations, including Massport-owned property, for a relocation site in South Boston.

5.7.4 Amtrak Downeaster Rail Service

The Downeaster is a regional passenger rail service that is managed by the Northern New England Passenger Rail Authority and operated by Amtrak. The service links Boston’s North Station to Brunswick, Maine with 10 intermediate stops. Five daily roundtrips are operated between Boston and Portland, Maine and three trains continue on to Brunswick. In FY 2012, ridership on the Downeaster set a new record increasing by 4.3 percent over the prior year to more than 541,000 passengers.

5.7.5 Pilgrim Partnership Commuter Rail Services

The Pilgrim Partnership is an arrangement between the MBTA and the Rhode Island Department of Transportation (RIDOT), under which RIDOT allocates some of its federal funding to the MBTA in return for commuter rail service between Boston from Rhode Island. Eighteen daily round-trips are provided between Boston and Providence. Expanded commuter rail service to T.F. Green Airport in Warwick, RI was introduced in 2010. Travel time between Boston and Warwick is approximately 1.25 hours, and 10 of the 18 daily Boston-Providence departures currently continue on to Warwick. Expanded service to Wickford Junction Station in Kingstown, RI commenced in 2012.

The extended commuter rail enhances ground access options from the Boston metro area to T.F. Green Airport. Based on the NERASP Study, the passenger catchment areas of T.F. Green and Logan Airport overlap, and this new commuter rail service has the potential to attract passengers in the overlapping catchment area living along the Providence/Stoughton MBTA commuter rail line to T.F. Green Airport.

5.8 Airport Ground Access Improvements

5.8.1 T.F. Green InterLink Facility

The new InterLink, an intermodal transportation hub near T.F. Green Airport, opened on October 27, 2010. The InterLink serves multiple transportation functions, including: Rhode Island Public Transit Authority (RIPTA) bus service; Massachusetts Bay Transportation Authority (MBTA) commuter train service between Warwick, Providence, and Boston; a consolidated car rental facility, and parking (for commuter rail service only); and a direct pedestrian link to the airport terminal. The rail platform is integrated with a consolidated rental car facility that houses airport rental car operations.

5.8.2 Long-term Worcester Roadway Improvements

In 2008, the Central Massachusetts Regional Planning Commission (CMRPC) initiated the Worcester Regional Mobility Study that was envisioned as a transportation plan with the goal of improving the movement of people and goods through the Greater Worcester Region. The final Study was released in May 2011. One of the Study's objectives was to improve ground transportation access between the regional roadways and Worcester Regional Airport within the context of an "economic development corridor" that could benefit other local businesses. Several alternative routes were identified and recommended for further study including a new interchange off the Interstate 90 in the vicinity of Route 56. The Study also assessed a range of alternatives to address regional mobility concerns and recommended thirteen roadway infrastructure improvement intended to reduce congestion, enhance regional mobility and address existing interchange/intersection constraints. The study presented the recommended phasing and packaging of recommended alternatives into short-term (0 to five years), mid-term (five to ten years) and long-term actions (over ten years).

5.8.3 Near-term Worcester Directional Signage Improvement Program

CMRPC also supported Massport's goal to identify immediate actions for improving roadway access to Worcester through a signage improvement program. In collaboration with the MassDOT and the City of Worcester, Massport identified six primary routes now used by travelers to access Worcester. The team also developed a sign design and placement plan. The goal was to improve directional signage on these roads between Worcester and the Massachusetts Turnpike Pike and Interstate 290 by achieving the following objectives:

- To ensure that key decision points would be adequately signed;
- To reduce sign “clutter” by removing old and unnecessary signs; and
- To design and install new airport trailblazer signs consistent with Logan Airport and MassDOT way-finding standards.

MassDOT has installed the desired signs that were produced by the Massport Sign Shop. By 2013, 89 signs had been installed including several signs on Auburn roads approved by the Town of Auburn in March 2011. In 2013, in anticipation of JetBlue starting service in November, four existing best route signs on I-90 were upgraded of which two were upgraded to larger signs and two were supplemented with “x miles” marker tabs.

6 Ground Transportation

Chapter 6 describes the ground transportation system serving Hanscom Field and the relationship between the airport and that system. This chapter (1) compares year 2012 traffic data with data from the 2005 *ESPR*, (2) makes a retrospective comparison of existing conditions with forecasts from the 2005 *ESPR*, (3) provides a prospective assessment of the 2020 and 2030 future airport activity scenarios and (4) includes potentially beneficial environmental measures.

6.1 Key Findings Since 2005

Hanscom Field is an off-peak generator, meaning that peak traffic for Hanscom Field does not coincide with more general peak traffic in the area. Additionally, Hanscom-related traffic is only a small percentage of the total traffic along the nearby roadways and intersections studied. In fact, Hanscom traffic only contributed three to four percent of total traffic along Route 2A in 2012. Additionally, Hanscom traffic contributes 10% or more of the total traffic at only three of the sixteen nearby intersections studied. These trends are consistent with previous *ESPRs* and remain so in the 2020 and 2030 forecasted scenarios, which suggests that future *ESPRs* could study fewer intersections and direct effort to other issues.

This chapter details the minimal traffic impacts from Hanscom Field-related traffic on nearby roadways and intersections. Land use patterns, limited transit service and incomplete pedestrian and bicycle networks contribute to the relatively high percentage of single occupancy vehicle traffic in the area. This chapter explores the current Transportation Demand Management activities in proximity to Hanscom Field, describes current efforts to reduce single occupancy vehicle trips to Hanscom and discusses opportunities for expanding on existing mitigation efforts. The 2012 *ESPR* future scenarios are used to evaluate the potential cumulative environmental effects that could occur if Hanscom Field reaches the airport activity levels that are described in Chapter 3, Airport Activity Levels. The 2020 and 2030 scenarios represent estimates of what could occur related to airport ground transportation (not what will occur) in the future using certain planning assumptions and are not necessarily recommended outcomes.

The traffic forecasts include vehicle trips from Hanscom Field, future background traffic growth, and specific planned developments in the area. Information about recently completed and planned development projects was provided by the town planners from Bedford, Concord, Lexington and Lincoln. The critical finding of this updated traffic analysis is reconfirmation that Hanscom Field is not a significant contributor to traffic volumes on the surrounding roadways. Commercial and residential developments, coupled with the local reliance on single occupancy vehicles, remain the most significant sources of existing and future traffic volumes on area roadways.

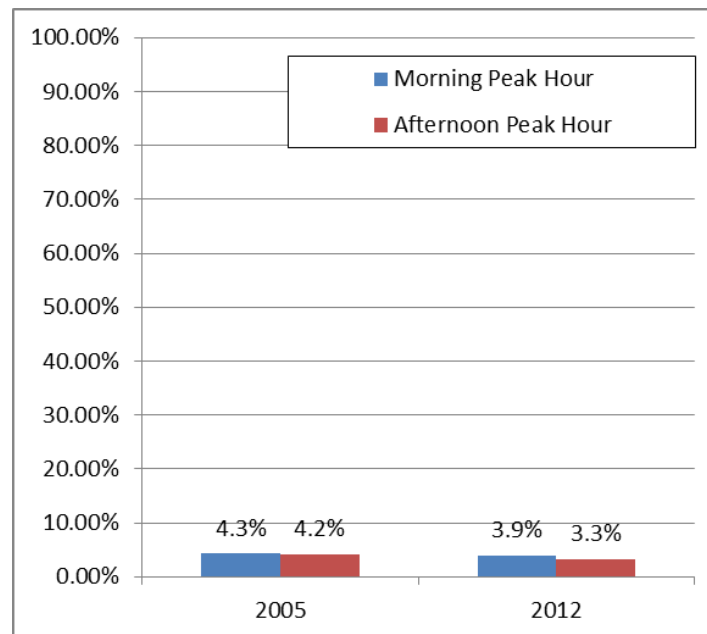


Figure 6-1 Percent of Hanscom Field Traffic on Route 2A East of Hanscom Drive

As Figure 6-1 indicates, Hanscom Field traffic makes up approximately four percent of the traffic on Route 2A during the morning peak hour and approximately three percent during the afternoon peak hour in 2012, which is similar to 2005. Both the Hanscom Field and Route 2A traffic decreased between 2005 and 2012. Furthermore, traffic arrivals and departures by Hanscom Field employees and passengers generally avoid peak hour congestion.

The average daily traffic volumes on Hanscom Drive, the primary access road to Hanscom Field from the surrounding roadways, decreased from 2,600 vehicles in 2005 to 2,200 in 2012, primarily as a result of a reduction in commercial air passenger activity and a reduced class schedule at the flight school (i.e. WyoTech, the predecessor to National Aviation Academy, had a part-time evening program in 2005). Additionally, the amount of peak hour traffic generated in 2012 by Hanscom did not change significantly from the 2005 *ESPR* as indicated in Table 6-1.

The increased amount of peak hour traffic in the 2012 *ESPR* for the 2020 and 2030 scenarios is attributable to the increased aviation activity that is described in Chapter 3, Airport Activity Levels and other airport-related land uses such as a hotel and museum.

Table 6-1 Hanscom Field Vehicular Trip Generation

Year/Scenario	Morning Peak Hour	Afternoon Peak Hour
2005 Actual	157	154
2012 Actual	165	121
2020 Forecast	220	166
2030 Forecast	384	336

As a result of the refinements to the aviation activity forecasts, these traffic volume estimates are generally less than the increases forecast in the 2005 *ESPR*. Hanscom traffic patterns and their effect on local roadways are similar in the 2020 and 2030 scenarios. Hanscom traffic increases would represent a small percentage of Route 2A traffic volumes, and a small portion of the total increase in intersection traffic as compared to 2005 volumes. In addition, intersection analysis with SYNCHRO 7.0 software indicates that most intersections operate at the same level of service (LOS) regardless of the forecast Hanscom Field-related traffic growth.

The results of an employee commute survey indicate that 87 percent of respondents drove alone to Hanscom Field. Despite this large percentage of lone commuters, there are opportunities to reduce the number of single occupancy vehicles commuting each day given that 28% of survey respondents expressed interest in learning about programs and incentives encouraging alternate modes of transportation. Respondents expressed greatest interest in replacing vehicle trips with transit, followed by carpooling/vanpooling, bicycling, and walking.

Environmentally beneficial measures that emphasize Transportation Demand Management (TDM) are detailed at the end of this chapter. Recommended TDM strategies include promoting transit services, exploring partnerships with Hanscom Air Force Base, MassRIDES and the 128 Business Council; supporting carpools and vanpools and increasing the viability of active transportation. The intersection of Route 2A and Hanscom Drive may benefit from the use of additional traffic management approaches, especially if volumes reach the forecasted levels for the 2020 and 2030 scenarios. While the use of a traffic control officer or a traffic signal at Route 2A and Hanscom Drive would improve the operation of the intersection during peak hours, Hanscom Field-related traffic is only a small contributor to the total traffic at the intersection and the remainder is regional traffic and traffic from planned and anticipated projects in the study area.

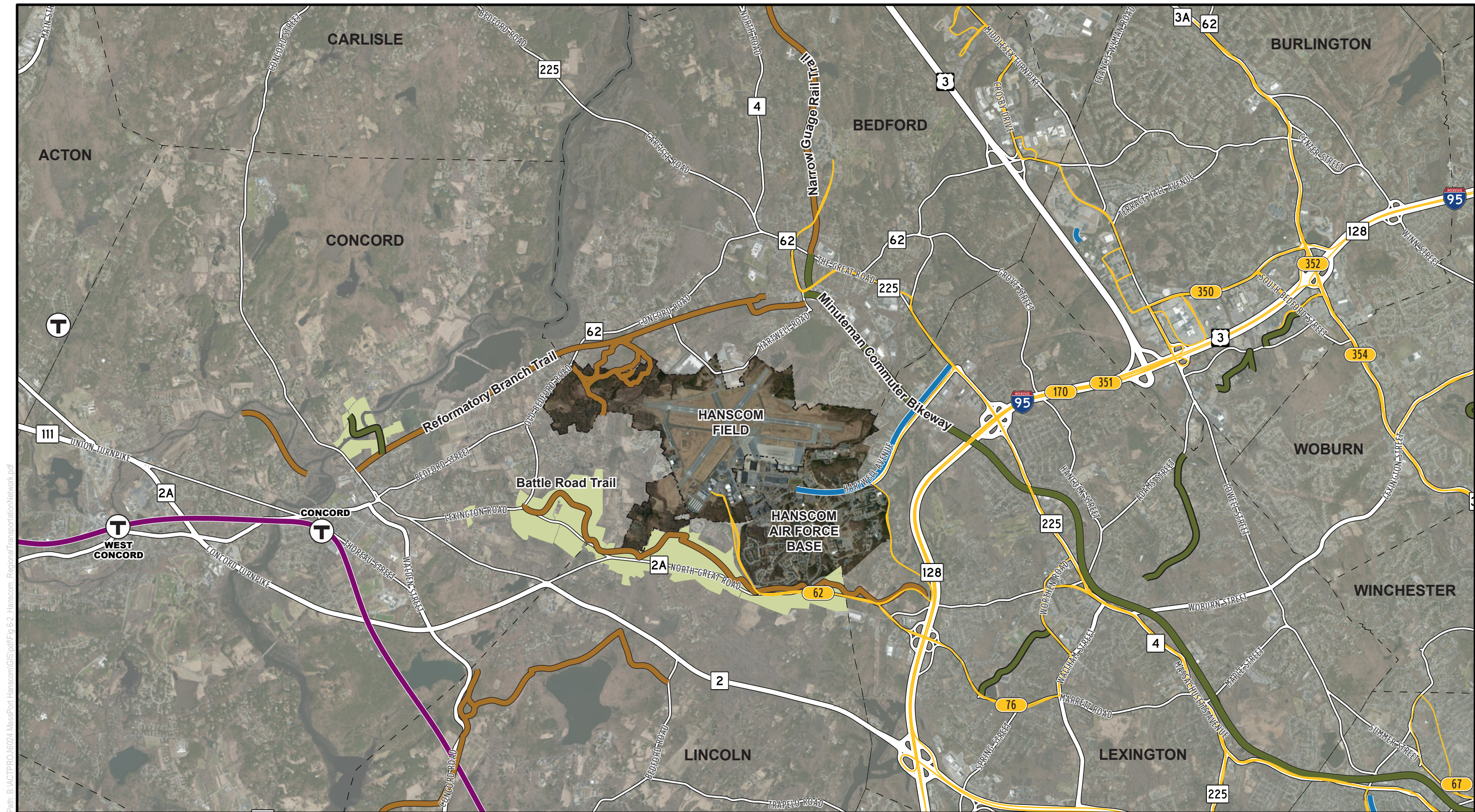
6.2 Regional Ground Transportation System

This section describes the regional ground transportation system surrounding Hanscom Field including (1) regional highway system, (2) transit (commuter rail and local service), (3) regional bicycle network, and (4) existing TDM programs.

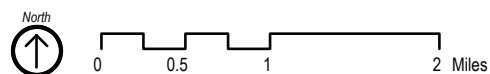
6.2.1 Regional highway system

A roadway network of major expressways, including Route 128/I-95, Route 2, Route 3, and the Massachusetts Turnpike (I-90) surrounds Hanscom Field, as Figure 6-2 illustrates. Route 128/I-95 Exit 30 (Route 2A) is the closest highway exit for Hanscom Field, although Exit 31 (at Route 4-225) also provides access to Hanscom. Route 2A, which is designated as the Battle Road Scenic Byway, provides primary east/west access to and from Hanscom with direct access to Hanscom Field provided via Hanscom Drive. Traffic to and from the north may approach Hanscom Field from Route 4-225 and Route 62 or from Route 128/I-95 while traffic to and from the south will primarily use Route 128/I-95. In the vicinity of Hanscom Field, most intersections are unsignalized, with the exception of Massachusetts Avenue. A left-turn lane is provided in the eastbound direction at Hanscom Drive. Traffic flows follow general commuting patterns of the area, with heavier eastbound flows toward Route 128 and Boston during the morning peak hour and heavier westbound traffic flows during the afternoon peak hour.

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Path: B:\ACTPROJ\06024 MassPort Hanscom\GIS\pdf\Fig 6-2. Hanscom Regional Transportation Network.pdf



- | | |
|------------------------------------|--|
| Airport Property Boundary | Hard Surface Path |
| Municipal Boundary | Natural Surface Path |
| Minuteman National Historical Park | MBTA Commuter Rail Station |
| Interstate Route | MBTA Commuter Rail Line (Fitchburg/South Acton Line) |
| Major Arterial | MBTA Bus Route |
| Minor Arterial | |
| Bike Lane (on-road) | |



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

**Hanscom Field
Regional Transportation Network**

Data Sources: MassGIS Basemap Layers, MAPC Bike/Ped Facilities 2013

Figure 6-2

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6.2.2 Regional rail and transit

Public transportation around Hanscom Field is relatively limited. Hanscom Field itself is served by MBTA Bus Route 76. The nearest commuter rail station to Hanscom Field is located at Concord Center. The area is also served by other bus services such as Lexington's LEXPRESS, as well as point-to-point shuttle services (described in more detail below).

6.2.2.1 Commuter rail

The Fitchburg Line Commuter Rail station in Concord, located at 90 Thoreau Street, provides the nearest rail access to Hanscom Field. Service at the Concord Station operates from 6:00 a.m. to 1:00 a.m. The station is served by 16 inbound and 16 outbound trains daily. Five inbound trains stop in Concord during the morning peak periods and four outbound trains stop during afternoon peak. The station has 86 parking spaces and 10 spaces for bicycles. Crosby's Market, located across from the Concord Center commuter rail station has designated a small supplemental parking area for motorists using the commuter rail. The Town of Concord Parking Study (2013) indicated that the commuter parking near Concord Station is nearly 100% utilized. Additionally, field observations indicate that the existing bicycle parking is highly utilized. The Town of Concord Parking Study includes several recommendations to improve management of the Town's parking lots at the Concord commuter rail station such as expanding the existing resident commuter rail parking permit program at the Concord Center commuter rail stop; requiring permits at Crosby's Market lot, on Cottage Lane, and in the Love Lane lot; adding daily pay spaces at the Depot lot; and providing covered, secured bicycle parking to replace existing bicycle parking. This commuter rail station is located about five miles from Hanscom Field and is not served by local bus routes.

6.2.2.2 MBTA surface bus

Hanscom Field is served by MBTA Route 76, which runs between Alewife Station and the Civil Air Terminal. Route 76 operates between 6:00 a.m. and 10:30 p.m. on weekdays with 40 minute headways during morning commute hours, half-hour headways during the evening commute hours and hourly service midday and late evenings. The Route 76 bus combines with MBTA Route 62 for Saturday service between Alewife Station and Bedford V.A. Hospital with a stop at the Civil Air Terminal. Saturday service operates from 7:00 a.m. to 9:00 p.m. with approximately one-hour headways. No MBTA service is provided for these routes on Sundays.

6.2.2.3 Other local bus service

Other bus services in this area include the Alewife Shuttle (sponsored by the South Lexington Management Association), a shuttle service between Cambridge and MIT Lincoln Labs, and a neighborhood bus system called LEXPRESS, which is subsidized by the Town of Lexington and the MBTA, and operated by M&L Transit Systems. LEXPRESS buses start at Depot Square in Lexington and operate on six fixed routes, each with one hour headway, running from 7:00 a.m. to 6:30 p.m. on weekdays. LEXPRESS routes operate almost entirely within Lexington town limits. Several of the LEXPRESS routes cross the MBTA Route 76, which services Hanscom Field. The LEXPRESS routes closest to Hanscom Field are route #4 and route #2, which are approximately two to three miles from Route 2A & Hanscom Drive.

6.2.2.4 Liberty Ride bus tours

The Liberty Ride offers bus tours to historical sites in Lexington and Concord along the Battle Road Trail weekends in April and May and daily from May 28 through October 28. The buses depart from the Lexington Visitors Center at 1875 Massachusetts Avenue at 10:00 a.m., 11:30 a.m., 1:00 p.m. and 2:30 p.m. The bus is accessible by the MBTA Red Line and MBTA bus routes 62 and 76 from Alewife Station.

6.2.3 Regional bicycle network

Hanscom Field is near the Minuteman Commuter Bikeway, an 11 mile paved trail that extends from Alewife Station in Cambridge to Depot Park in Bedford. It is open from 5:00 a.m. to 9:00 p.m. year round. The towns of Arlington, Lexington and Bedford recently partnered to undertake a project called “Navigating the Minuteman Commuter Bikeway.” The project developed recommendations for enhancing this popular trail including a new wayfinding system to better connect the trail to the adjacent communities.

There are two other unpaved bike trails that act as extensions to the Minuteman Bikeway, both starting from near the end of the Bikeway in Bedford. The Bedford Narrow Gauge Rail-Trail extends three miles to North Billerica, while the Reformatory Branch Rail-Trail ends near the Old North Bridge in Concord. While the Reformatory Branch is currently unpaved, the town of Bedford has expressed interest in paving the sections of trail within the town of Bedford to make the trail accessible to more types of users.

The six miles of Battle Road Trail in the Minute Man National Historical Park are also a resource for bicycle riders offering cycling, pedestrian and wheelchair access to the National Park Service’s historic and natural resources. However, these trails are not paved or directly linked to the other regional trails. The Town of Concord has expressed interest in providing links between these paths. As illustrated in Figure 6-2, connecting existing paths would strengthen the overall network of bicycle and pedestrian paths serving the towns, Minute Man Historical Park and Hanscom Field.

In addition to off-street trails, towns around Hanscom Field have been making bicycle improvements to their street networks. Lexington has recently installed shared lane markings on town streets and Bedford is working to have bicycle lanes installed on Hartwell Road.

6.2.4 Transportation Demand Management

The purpose of TDM is to make better use of existing transportation facilities with the objective of reducing the peak hour demand for automobile trips. TDM is a cost-effective alternative to increasing roadway capacity to accommodate increasing peak demand. Examples of TDM measures include augmented transit service, carpool/vanpool programs, employee rideshare programs, bike/walk incentive programs, and staggered work hours. Often it is possible to combine TDM programs with other near-by businesses. Transportation Management Associations (TMAs) organize participants to share the costs of TDM programs and maximize the potential benefits.

There are several organizations involved with TDM programs in the Hanscom Field area. These include MassRIDES, the 128 Business Council, MAGIC, and Hanscom AFB, which are described below.

6.2.4.1 MassRIDES

Since January 2004, MassRIDES has provided free TDM planning assistance for commuters and employers statewide. MassRIDES, administered by MassDOT, currently offers a comprehensive package

of transportation information and an array of incentives designed to encourage commuters to travel to work together. MassRIDES has administered the Transportation Management Initiative (TMI) on behalf of MassDOT since January 2006. This program funds a MassRIDES staff coordinator to plan and administer TDM actions with members. Benefits are provided based on the level of participation in TDM with employees of partner companies. One of the key incentives is eligibility for the MassRIDES Emergency Ride Home program to provide frequent alternative mode users with dedicated transportation for unexpected occurrences like sickness or child care schedule changes.

MassRIDES services include a ridesharing program (through NuRide), employer outreach, assessment of travel options at large worksites, the Emergency Ride Home Program, training and guidance, and coordination of over 40 vanpools. In addition to these features, employers may choose to provide additional incentives for ridesharing, such as parking cash out (which is when an employee is reimbursed for the cost of a parking space he/she does not use); preferential parking for registered carpools and vanpools; bicycle racks; employee lockers and showers; commuter tax benefits, or other financial incentives.

NuRide, partnered with MassDOT, is a commuter-side rewards program for individuals who choose greener forms of transportation including walking, bicycling, carpooling, vanpooling, public transportation, and telecommuting. The free service is supported by sponsors who provide commuters with special offers for taking trips that reduce environmental impacts and traffic congestion. NuRide provides trip planning, ride-matching with other “NuRiders,” and information about transportation options.

6.2.4.2 The 128 Business Council

The 128 Business Council (128BC) is a TMA that offers a variety of alternative transportation services in the towns of Lexington, Waltham, Needham, Newton, Weston, Woburn and Burlington. The 41-member organization provides transportation planning services, shuttle services, corporate assistance, commuter planning, alternative commuting programs, and ridesharing coordination for organizations with a large number of employees. Their current programs include shuttle services from Lexington and Waltham to Alewife, Bentley College shuttle services in Waltham, two local Waltham shuttles, a Needham shuttle from the Green Line, and the MetroNorth shuttle service from Woburn, Burlington, and Lexington to the Anderson Regional Transportation Center (ARTC). The Council recently added a new shuttle called “The Rev” to service businesses along Hartwell Avenue.

6.2.4.3 Minuteman Advisory Group on Interlocal Coordination

The Minuteman Advisory Group on Interlocal Coordination (MAGIC) is a sub-group of the Metropolitan Area Planning Council (MAPC). MAGIC addresses community planning issues that are of interest to its member communities. This group meets monthly, and as necessary, assists with TDM for thirteen towns in the MAGIC sub-region, including Lexington, Lincoln, Bedford and Concord. MAGIC supports the development of alternative solutions to single occupancy vehicles, as well as education about and promotion of their programs.

6.2.4.4 Hanscom Air Force Base

TDM measures have been used at Hanscom AFB as part of its efforts to reduce the number of single occupant vehicles commuting to the Base. The Base has partnered with vRides to promote vanpooling among employees. There is currently a vanpool coming from Nashua, NH that provides four trips per day

and officials at the AFB are looking into starting new vanpools to accommodate the influx of new employees associated with the recent National Guard relocation to the Base.

MIT Lincoln Labs has a mini-bus from Alewife station that is available to all employees at the Base. MIT also has a very active bicycle commuting population and provide services including covered bike parking and a self-service bike repair station.

The Base currently offers a Transportation Incentive Program that reimburses employees who use transit or carpool. There are discussions about installing a bike share on Base for people to use when going to meetings at other buildings. In addition, the Base held a bike challenge during the month of June 2013 to encourage more employees to commute on their bike.

6.3 Regional Transportation Planning Context

The relatively high level of single occupant vehicle commuting has influenced the transportation planning context for the area around Hanscom Field. The lack of residential and commercial density limits the effectiveness of mass transportation, other than trips into and out of Boston, and challenges the development of effective regional TDM approaches. However, the regional transportation planning process has fostered the creation of regional bike paths and the emergence of shuttle services to make more effective use of existing resources. More recently, efforts have begun to focus on transit-oriented development approaches that encourage the types of densities and mixes of uses that support transit use, walking and bicycling. Regional transportation planning is conducted through the Boston MPO, which was established to oversee federally funded transportation plans and programs. This section describes the structure of the MPO planning process and the key planning documents affecting ground transportation access at Hanscom Field.

6.3.1 Metropolitan Planning Organization

The Boston MPO region encompasses 101 cities and towns, including Bedford, Concord, Lexington and Lincoln. The MPO has 19 voting members which include:

- State agencies: MassDOT, MBTA and Massport;
- Regional organizations: Metropolitan Area Planning Council, and the Regional Transportation Advisory Council;
- Six cities: Boston, Beverly, Everett, Newton, Somerville, and Woburn;
- Seven towns: Arlington, Bedford, Braintree, Framingham, Lexington, Medway, Norwood;
- Two ex-officio members: Federal Highway Administration and Federal Transit Administration, working jointly with the MBTA Advisory Board, administer the municipal nomination and election process.

6.3.2 Transportation planning documents

Federal surface transportation legislation sets forth the requirements for the metropolitan planning process that is overseen by the MPO agencies. The MPO receives input from the Regional Transportation Advisory Council (RTAC), which ensures citizen participation, and the Central Transportation Planning Staff (CTPS), which provides technical and policy analysis to the MPO. The following are metropolitan planning documents that affect access to Hanscom Field.

6.3.2.1 2012-2035 Long Range Transportation Plan

Paths to a Sustainable Region is the regional long-range transportation plan (LRTP) that identifies transportation facilities, programs and major investments to support and expand the region's multimodal transportation system. The plan includes both a financial plan to demonstrate how the measures included in the plan can be implemented as well as an air quality analysis to demonstrate conformity with federal standards. The plan was adopted by the MPO in September 2011, and was updated most recently in June 2012. The LRTP is used by the MPO to set transportation priorities among various roadway and transit projects and to consider improvements to the region's multimodal transportation system in broad terms. The LRTP does not prioritize any projects in close proximity to Hanscom.

6.3.2.2 Program for Mass Transit

The Program for Mass Transit (PMT) is a long-range transit plan that evaluates and recommends transit projects to preserve, enhance and expand the MBTA system. The PMT describes the MBTA's fiscally-unconstrained capital investment plan. Any transit project eligible for federal funds must be included in the PMT. The PMT was last revised in January 2004. There are no projects within the PMT that would affect access to Hanscom Field.

6.3.2.3 Transportation Improvements Plan

The MPO programs federally fund roadway and transit projects through the Transportation Improvement Plan (TIP). The TIP is a five-year plan that is updated annually by the MPO. The most recent TIP was updated by the MPO on June 28, 2012. The TIP includes funding for Limited Access Highway Improvements at Route 2 & 2A between Crosby's Corner and Bedford Road, which is currently under construction. Improvements include construction of new neighborhood service roads parallel to Route 2 and a new bridge on Route 2. The TIP also includes funding to replace a bridge at Route 2A and I-95 in Lexington. The proposed bridge will maintain the current alignment and facilities, including four 11.5 foot travel lanes, two 11.5 foot speed change lanes, a 6 foot median and a 6 foot northerly sidewalk. This interchange was included in the list of top 25 crash locations in the Boston region between 2006 and 2008 and is approximately three miles from Hanscom.

6.3.2.4 Mobility in the Boston Region: the 2004 Congestion Management System Report

The Congestion Management System (CMS) report identified mobility concerns for each subregion in the MPO region including the MAGIC subregion. The report recommended further study of Route 2A from Lincoln to Route 3/3A in Arlington with an emphasis on traffic signal control and pedestrian and bicycle movement. The report listed three specific recommendations for the MAGIC subregion:

1. Continue to investigate improvements along Route 2 between the Concord Rotary and the Piper/Taylor Road intersection in Acton.
2. Proceed with production of the environmental documents and design for the grade separation at the Concord Rotary, following the completion of the CTPS study entitled *Route 2 Improvements from Route 111 in Acton to Baker Avenue in Concord: A Feasibility Study*.
3. Complete the final design and construct a grade separated interchange at Crosby's Corner at Route 2 at Cambridge Turnpike-Concord Turnpike, following the recommendations of the MassHighway Environmental Impact Report for Crosby's Corner. (Note: this project is currently under construction.)

6.3.2.5 MAGIC Subregional Area Study: Phase II Report

The MAGIC subregion includes the towns of Bedford, Concord, Lexington, Lincoln and nine other adjacent communities. The Phase II Report made specific suggestions based on the economic and transportation data presented in the Phase I Report. The principal task of the Phase II report was to investigate the potential for remote or satellite parking near existing MAGIC-area commuter rail stations. The report found that Concord, with its relatively dense town center, is a good candidate for a small bus or van connection between Concord Center and Concord Commuter Rail Station.

6.3.2.6 MAGIC Suburban Mobility Study

The MAGIC Suburban Mobility Study completed in 2011 incorporates the MAGIC Subregional Area Study Phase II Report and makes recommendations for transit improvements in the subregion. The 128 Business Council, one of two TMAs in the region expressed interest in expanding their services past Lexington to nearby communities on the 128 corridor, which could include Hanscom Field. The report recommends individual municipalities reach out to the 128BC to initiate coordination of services.

6.3.2.7 The Battle Road Scenic Byway Corridor Management Plan

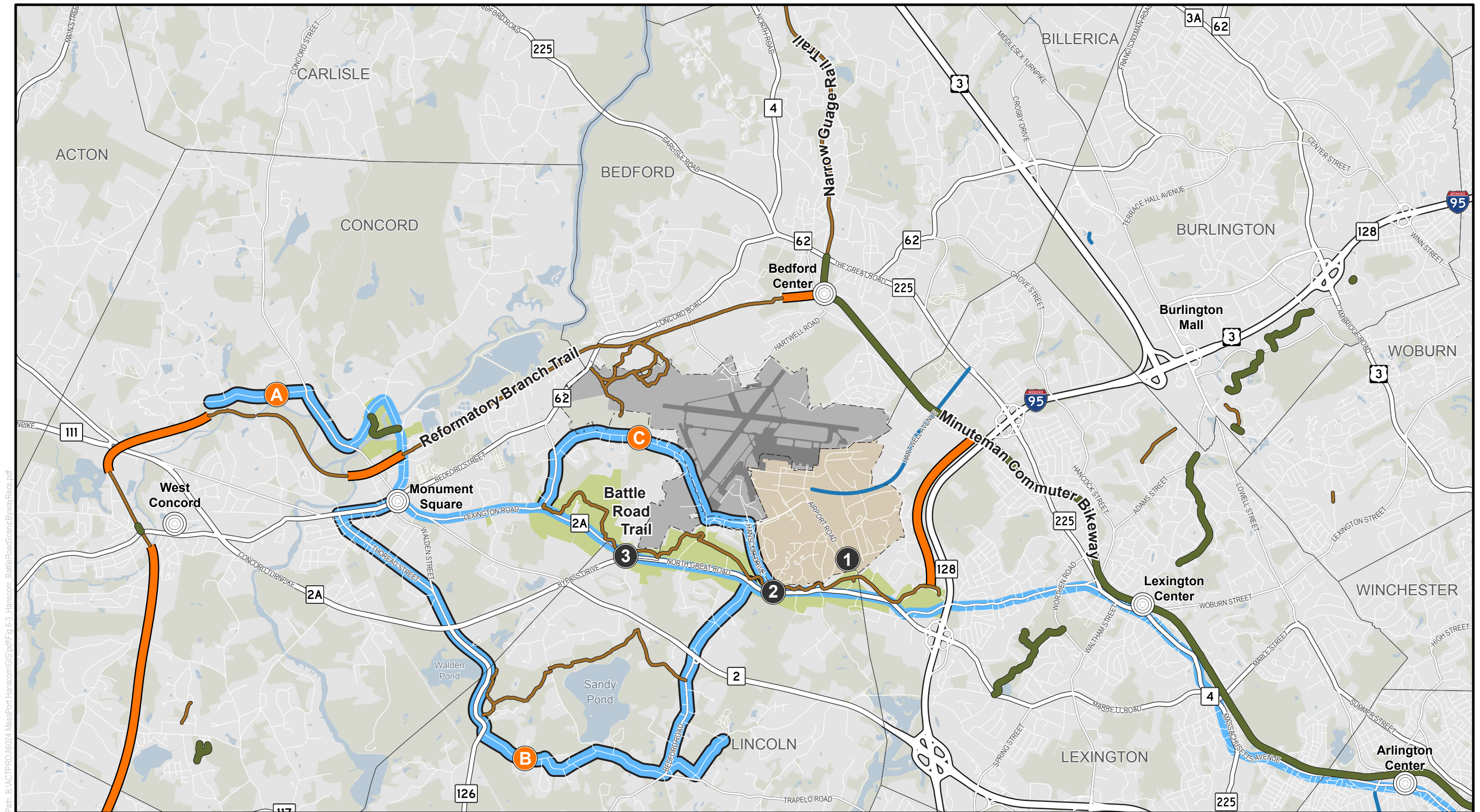
MAPC, along with the MassDOT, the Minute Man National Historic Park, and four towns (Arlington, Lexington, Lincoln, and Concord) have collaborated on The Battle Road Scenic Byway Corridor Management Plan. The plan proposes strategies to highlight the historical, cultural, recreational, scenic, and natural resources along the route through transportation and land use management and tourism. Figure 6-3 illustrates the recommendations and issues from the plan.

Among the plan's transportation recommendations, the working group proposed:

- Extending the Battle Road Scenic Byway three miles, including 0.8mi to the eastern end that would reach Alewife Brook Pkwy (outside the extents of Figure 6-3) in Cambridge, and 2.2mi in Concord from Liberty Road to Barrett's Mill Road (see "A" on Figure 6-3); if extended, the cohesive byway would connect Cambridge to West Concord;
- Creating two loops: a "southern loop" (see "B" on Figure 6-3) that connects Concord Center to Hanscom Drive in Lincoln, and a "northern loop" (see "C" on Figure 6-3) that connects Hanscom Drive to 2A at North Great Road; and Expanding the network of shared-use paths paralleling the Byway to increase bicycle and pedestrian traffic where feasible.

The northern loop would begin at the western edge of Hanscom Field. The report suggests highlighting several landmarks near Hanscom, including Lincoln Laboratories, and the AFB. If realized, the scenic loops would potentially increase traffic at Hanscom Field.

The report details transit accessibility and ridership trends along the byway, including MBTA bus routes 62, 67, 76, 77, 79, and 350; the LEXPRESS bus; and private shuttles operated by Hanscom AFB, MIT, and the 128 Business Council. Both the LEXPRESS and 128BC shuttles saw increasing ridership between 2005 and 2009 (serving 70,000 and 90,000 annual riders respectively), and the Hanscom AFB shuttles saw a 66% increase over the same period (in 2009 providing 30,000 rides).



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- Hanscom Field
- Hanscom Air Force Base
- Municipal Boundary
- Town Center
- Minuteman National Historical Park

- Hard Surface Path
- Natural Surface Path
- Bike Lane
- Proposed Path
- Battle Road Scenic Byway
- Proposed Addition to Battle Road Scenic Byway

- Proposed Improvement
- Area of Traffic Concern



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

**Battle Road Scenic Byway Corridor
Management Plan (MAPC, 2011)**
Summary of Recommendations

Figure 6-3

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The report also names fourteen “areas of traffic concern,” or sections and intersections where there is a need to address and modify the design and conditions. Three locations are at entries/exits to Hanscom Field: Airport Road and Marrett Street (see “1” on Figure 6-3); North Great Road (Route 2A) and Hanscom Drive (see “2” on Figure 6-3); and North Great Road and Bypass Road (see “3” on Figure 6-3). Recommended modifications are not specific, but may include updating signal timing, creating lower-stress crossings for pedestrians and bicyclists, and improving sight lines. Each of the locations is in Lincoln, and would require collaboration with the Town of Lincoln and MassDOT as primary stakeholders.

The plan’s transportation recommendations focus on cultivating comfortable bicycle and pedestrian facilities to promote enjoyment of the scenic route (including separated and on-road bicycle facilities, and traffic calming measures); maintaining high quality pavement; creating a Scenic Byway signage program; considering a reconfiguration of Hanscom Drive to eliminate slip lanes and slow turning vehicles; and improving continuous transit access to all parts of the Byway.

6.3.2.8 Statewide GreenDOT Initiative

The MassDOT launched the GreenDOT Initiative in June 2010, a comprehensive sustainability initiative that explicitly aims to reduce single-occupancy vehicle trips in Massachusetts 25% by 2020, and triple the rates of bicycling, walking, and transit use by 2030. GreenDOT is driven by three goals:

- Reduce greenhouse gas (GHG) emissions;
- Promote the healthy transportation options of walking, bicycling, and public transit; and
- Support smart growth development.

The initiative was designed in response to several major state legislative requirements, including the Global Warming Solutions Act of 2008, and the Healthy Transportation Compact in 2009. The Global Warming Solutions Act sets forth targets of reducing greenhouse gas emissions economy-wide 25% from 1990 levels between 2010 and 2020. The Healthy Transportation Compact requires inter-agency cooperation in transportation projects to decrease greenhouse gas emissions; increase pedestrian and bicycle trips; increase access for travelers with mobility impairments; work with an advisory board to ensure projects meet complete streets criteria; implement health impact assessments on transportation systems; and increase public-private partnerships that support healthy transportation decisions. GreenDOT is meant to assist MassDOT in satisfying these requirements.

GreenDOT sets forth sixteen goals in seven categories that aim to embed sustainability into MassDOT’s core business practice, and together will turn the focus of transportation planning and design statewide to include all potential transportation modes while increasing project effectiveness and reducing negative environmental impact.

6.4 Year 2012 Traffic Conditions

Different factors influence 2012 ground transportation conditions at Hanscom Field and within the surrounding study area roadway network. This section describes the (1) vehicular trip generating characteristics of Hanscom Field, (2) traffic volumes for study area roadways, (3) traffic volumes for study intersections, and (4) intersection operating level of service. Supporting data is provided in Appendix C.

6.4.1 Hanscom Field trip characteristics

There are a variety of activities at Hanscom Field that generate automobile traffic and create ground transportation needs, including general aviation, commercial aviation, employment, students programs at National Aviation Academy and the flight schools and other business activities that support Hanscom Field operations. Employers include Massport, FAA, Linear Air, Jet Aviation, Signature Flight Support, East Coast Aero Club, Executive Flyers Aviation, and Corporate Limousine, among others.

6.4.1.1 Travel modes

Automobile use is the primary ground mode of travel to and from the Hanscom Field. Massport conducted a survey of employees and students in July 2013 as a part of the *2012 ESPR* to understand the general travel patterns. Table 6-2 provides a comparison of survey results between a similar survey conducted for the *2005 ESPR* and the 2012 survey. The results of the survey, which are reported in Appendix C, indicate that 87 percent of respondents drove alone to Hanscom Field. The remainder took public transportation or bicycled. None of the employees said they carpooled or were dropped off. These results are consistent with the 2005 survey of employees and students in that the majority drive personal vehicles. The percentage of employees and students who took public transportation or rode a bicycle to work increased since the 2005 survey. The 2005 survey found that some respondents carpooled or were dropped off, while the 2012 found that no respondents did. The high level of auto use is consistent with general travel patterns in the area. Additional details on the results of the summary can be found in Appendix C.

Table 6-2 Hanscom Field mode choice

Mode	2005 ESPR Survey (2005)	2012 ESPR Survey (2013)
Drove alone	87%	86%
Dropped off	1%	0%
Car pool	10%	0%
Public Transportation	2%	12%
Bicycle	0%	2%
Total	100%	100%

Source: Massport, Hanscom Field 2005 Draft Environmental Status and Planning Report, (2006) and *2012 ESPR* Travel Survey.

6.4.1.2 Vehicle occupancy survey

Vehicle occupancy data was also collected on Monday, December 17 and Wednesday, December 19, 2012 to quantify the number of persons per vehicle entering and exiting Hanscom Field. Additional information is provided in Appendix C. The number of persons and vehicles entering and exiting Hanscom Field were counted from 6:00 to 9:00 a.m. and 3:00 to 6:00 p.m. on Monday, December 17 and Wednesday, December 19, 2012 to estimate the Vehicle Occupancy Rate (VOR) for the airport. This study indicates that the airport had a total VOR of 1.11 passengers (MBTA buses ridership was not included). The VOR in the morning peak period was 1.06 (1.11 entering and 1.02 exiting) compared to 1.15 in the *2005 ESPR*. The VOR was 1.12 (1.09 entering and 1.13 exiting) in the afternoon peak period compared to 1.13 in the *2005 ESPR*. This reduction in vehicle occupancy may be a result in fewer people carpooling or being dropped off.

6.4.1.3 Parking survey

A parking demand survey was conducted from 11:00 a.m. to 1:00 p.m. on Thursday, August 22, 2013. Vehicles were counted at the parking lots located at Hanscom Field and are described in Chapter 2,

Facilities and Infrastructure. The parking demand survey assessed 1,369 of the 1,567 spaces at Hanscom Field. The remaining parking spaces include 110 spaces inside T-hangars, 70 spaces associated with the Hangar 24 site that is currently under construction and 18 spaces associated with storage building used by FAA. The parking demand survey indicated that forty-one percent of the 1,369 assessed spaces were occupied. Thirty-five percent of the 667-space Civil Air Terminal Lot was occupied during the survey period. This lot is a shared parking facility that serves the Civil Air Terminal and various tenants throughout the airport. The results of this parking survey indicate that there is currently surplus of parking at Hanscom Field.

6.4.1.4 Hanscom Field trip generation

The number of trips generated by Hanscom during the peak hour is needed to determine the traffic impacts of Hanscom-related traffic to intersections in the study area. The peak hours for the analysis represent the time of day when traffic volumes along the adjacent roadways are highest. The morning and afternoon peak hour vehicular trip generation for Hanscom Field is presented in Table 6-3. This data indicates that the number of morning and afternoon peak hour vehicle trips to and from Hanscom Field in 2012 is comparable to the 2005 vehicle trips. During the morning peak hour, entering traffic accounts for 82 percent of the peak hour volumes. The afternoon peak hour showed a similar split favoring the exiting vehicles with 69 percent and 31 percent entering.

Table 6-3 also includes the 2005 *ESPR* projections for the 2010 Moderate and High Growth scenarios. Comparison of actual year 2012 traffic data with year 2010 projections from the 2005 *ESPR* show that actual 2012 traffic volumes are below the 2005 *ESPR* projections for the morning and afternoon peak hours. This difference can be attributed to the fact that the actual total aircraft operations at Hanscom Field in 2012 were 13 to 18 percent below the forecast ranges presented in the 2005 *ESPR*. Specifically, the two 2010 scenarios from the 2005 *ESPR* included a significant amount of commercial air passengers (190,548 and 234,440) when commercial air travel was very low and eventually discontinued in September 2012. Commercial air passengers dropped from 17,457 in 2005 to 8,609 in 2012. Further, general aviation operations in 2012 were 70 to 85% of the forecasts for year 2010 projections in the 2005 *ESPR*.

Table 6-3 Hanscom Field peak hour trip generation 1996, 2002, 2005, and 2012

Traffic Count Data	Morning Peak Hour			Afternoon Peak Hour		
	In	Out	Total	In	Out	Total
1996	61	33	94	43	70	113
2002	109	52	161	47	112	159
2005	115	42	157	75	79	154
2012	136	29	165	37	84	121
2005 ESPR Scenarios						
2010 Moderate Growth	143	63	206	65	113	178
2010 High Growth	196	111	307	100	165	265

Source: Massport, Hanscom Field 2005 Draft Environmental Status and Planning Report, EOE #5484/8696 (2006).

6.4.1.5 Hanscom trip making by time of day

Hanscom Field is an off-peak traffic generator, meaning that the peak traffic for many Hanscom activities occurs at a different time from the peak hours of the adjacent street traffic. The scheduling of businesses and schools at Hanscom avoid peak commuting hours. As shown in Figure 6-4, the peak hours of overall traffic on Route 2A occur from 7:30 to 8:30 a.m. and from 4:45 to 5:45 p.m. While Hanscom Field experiences a relatively steady flow of traffic throughout the day, the morning peak for Hanscom Field

occurs from 6:45 to 7:45 a.m. and the afternoon peak occurs from 2:30 to 3:30 p.m. One reason for this trip-making pattern at Hanscom Field is the traffic generated by the National Aviation Academy that has classes that run from 7:30 a.m. to 3:00 p.m.

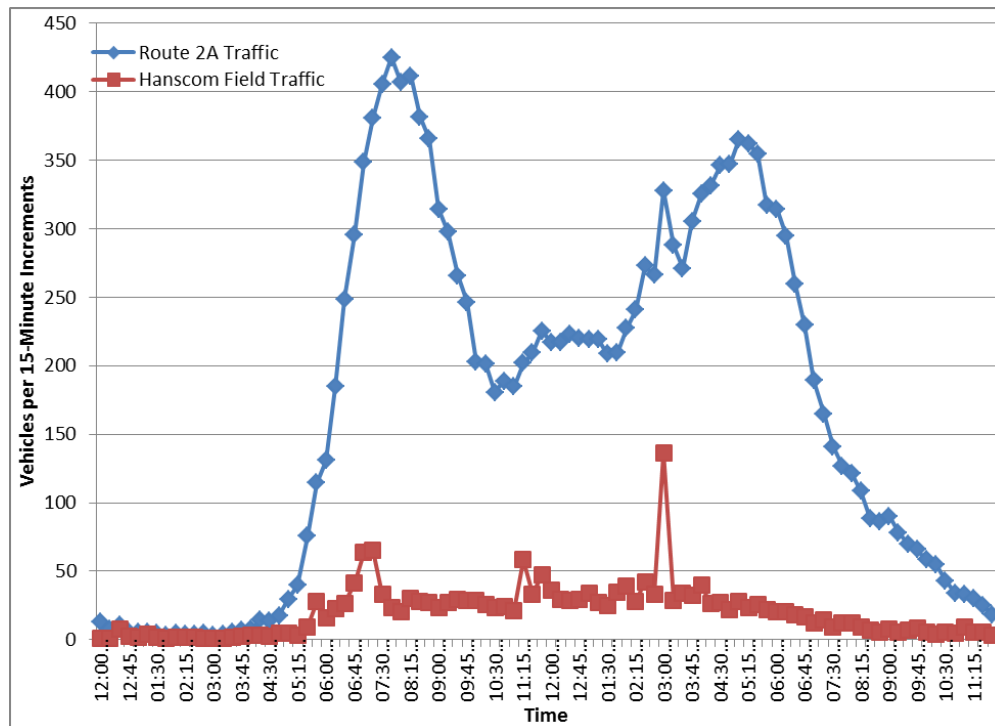


Figure 6-4 Peaking characteristics of Hanscom Field vehicle traffic study area

6.4.2 Study area roadways

The study area for ground transportation surrounding Hanscom is bordered in the northwest by Route 62 (Concord Road/Bedford St), in the northeast by Route 4-225 (Great Road/Bedford Street), in the east by Route 128/I-95 and in the south by Route 2A (Lexington Road/North Great Road). The roadways that are part of the study area are Route 62, Route 4-225, Route 2A, Massachusetts Avenue, Old Massachusetts Avenue, Airport Road, Hanscom Drive, Old Bedford Road, Virginia Road, Bedford Road, Hartwell Avenue, Lexington Road, South Road and Wood Street. This study area was used to analyze the effects of current and potential future traffic generated by Hanscom Field. Table 6-4 summarizes the study area roadway characteristics and functional classifications. The general characteristics of each roadway type, as described by the MassDOT Highway Design Manual, are as follows.

- **Arterial roadway** – This class of roadway provides a high level of mobility and access control. Arterial roadways provide the highest level of service at the greatest vehicle speed for the longest uninterrupted distance.

Table 6-4 Study area roadways

(See Figure 6-5 for locations)

Roadway (location)	Roadway type/ land use	Directional flow	Number of lanes	Posted Speed limit	Notes
Route 2A (Lexington/Lincoln)	Arterial - Primarily open space (Minute Man National Historic Park)	East/West	One in each direction	40 mph	Eastbound left turn lane at Hanscom Drive.
Route 62 (Concord/Bedford)	Arterial - Commercial/ Residential	Northeast/ Southwest	One in each direction	30-40 mph	Connection between Bedford and Concord centers.
Route 4-225 (Bedford)	Arterial - Commercial/ Residential	Northwest/ Southeast	One in each direction	30-40 mph	Turning lanes at some signalized intersections. Connection between Bedford and Lexington centers.
Hanscom Drive (Lincoln)	Collector - Open Space	North/South	Two in each direction with wide median	30 mph inbound; 20 mph outbound (North of Old Bedford Road)	Main access for Hanscom Field and secondary access for the USAF Base (Vandenberg Gate). Access to Old Bedford Road in Lincoln, which connects with Virginia Road. Speed limit not posted south of Old Bedford Road.
Virginia Road (Concord/Lincoln)	Local - Residential/ Office/Research	East/West	One in each direction	25-30 mph	Alternative access route to Hanscom Field without using Route 2A. Pavement is in poor condition and road is narrow and winding.
Bedford Road (Lincoln)	Collector - Residential	North/South	One in each direction	35 mph	Connections to Route 2 and 2A.
Lexington Road/Route 2A (Concord)	Arterial - Open Space (Minute Man National Historic Park)/Residential	East/West	One in each direction	30 mph WB; 40 mph EB	Route 62 connection west of Hanscom Field in Concord.
Old Bedford Road (Concord)	Collector - Residential	North/South	One in each direction	30 mph	Connection between Route 62 and Routh Road.
Hartwell Avenue (Bedford)	Collector - Residential /Office/Research	East/West	One in each direction	25-30 mph	Connection between Route 62 and South Road.
South Road (Bedford)	Collector - Residential	North/South	One in each direction	30 mph	Connections to Hartwell Road in Bedford, Hartwell Avenue in Lexington, and Route 4-225.
Hartwell Avenue (Lexington)	Collector - Primarily Office/Research and Industrial	North/South	One in each direction	40 mph	Connection between Route 4-225 and Wood Street. Access to USAF Base. Functions as two lanes in each direction in some segments.
Wood Street (Lexington)	Collector - Residential	North/South	One in each direction	30 mph	Connection between Hartwell Avenue and Massachusetts Avenue (to Route 2A). Provides access to USAF Base.
Massachusetts Avenue (Lexington)	Collector - Residential	East/West	One in each direction	35 mph	Connection between Lexington Center and Route 2A.
Old Massachusetts Ave. (Lexington)	Local - Open Space (Minute Man National Historic Park)/Residential	East/West	One in each direction	35 mph	Connection between Wood Street and Route 2A.
Airport Road (Lincoln/Lexington)	Collector - Residential	North/South	One in each direction	30 mph	Former entrance to USAF Base. Speed limit not posted.

- **Collector roadway** – Collectors provide a less highly developed service at a lower speed for shorter distances. Compared to arterials, collector roads provide both mobility and land access. Vehicles traveling on local roadways meet, and traffic funnels onto collector roads.

- **Local roadway** – Local roads provide access to abutting land with little or no through movement. This classification includes all roads not classified as either arterial or collector. Local roadways provide little mobility and a great deal of land access and local circulation at low speeds.

Traffic counts were collected on roadways in the study area during a 7-day period from Tuesday, November 13, 2012 through Monday, November 19, 2012 by automated traffic recorders (ATRs). These counts provide a better understanding of the current traffic patterns in certain areas surrounding Hanscom Field. The locations were chosen based on previous report counts and to confirm traffic volumes at intersections. The year 2012 ATR count locations are shown in Figure 6-5 and include:

- **Location A:** Route 2A, east of Airport Road (Lexington)
Due to an error in the recording device at this location, an additional 72-hour ATR count was taken from Tuesday, February 26, 2013 through Monday, March 4, 2013 and included in the 2012 network.
- **Location B:** Bedford Road, south of Route 2A (Lincoln)
- **Location C:** Cambridge Turnpike Cutoff, southwest of Lexington Road (Lincoln, near Concord line)
- **Location D:** Old Bedford Road, north of Virginia Road (Concord)
- **Location E:** Route 62, west of Old Bedford Road (Concord)
- **Location F:** Hanscom Drive, north of Old Bedford Road (Lincoln)

6.4.2.1 Daily traffic volumes

Year 2012 daily traffic volumes are presented in Figure 6-6, and compared with daily traffic volumes from the 2005 *ESPR* for 2002 and 2005 in Figure 6-7. Average daily traffic volumes on Hanscom Drive are approximately 2,200 vehicles per day, 15 percent less than the 2005 volumes. This decrease may be attributable to the discontinuation of commercial air travel and a reduced class schedule (i.e. WyoTech, the predecessor to NAA, had a part-time evening program in 2005). Route 2A, Bedford Road and Cambridge Turnpike Cut-off all experienced a small decrease (approximately 1-2% per year) between 2005 and 2012, which is consistent with other recent counts available from MassDOT. The former Raytheon facility on Hartwell Road was taken over and occupied by Instrumentation Labs which likely resulted in increased traffic volumes along both Route 62 and Old Bedford Road.

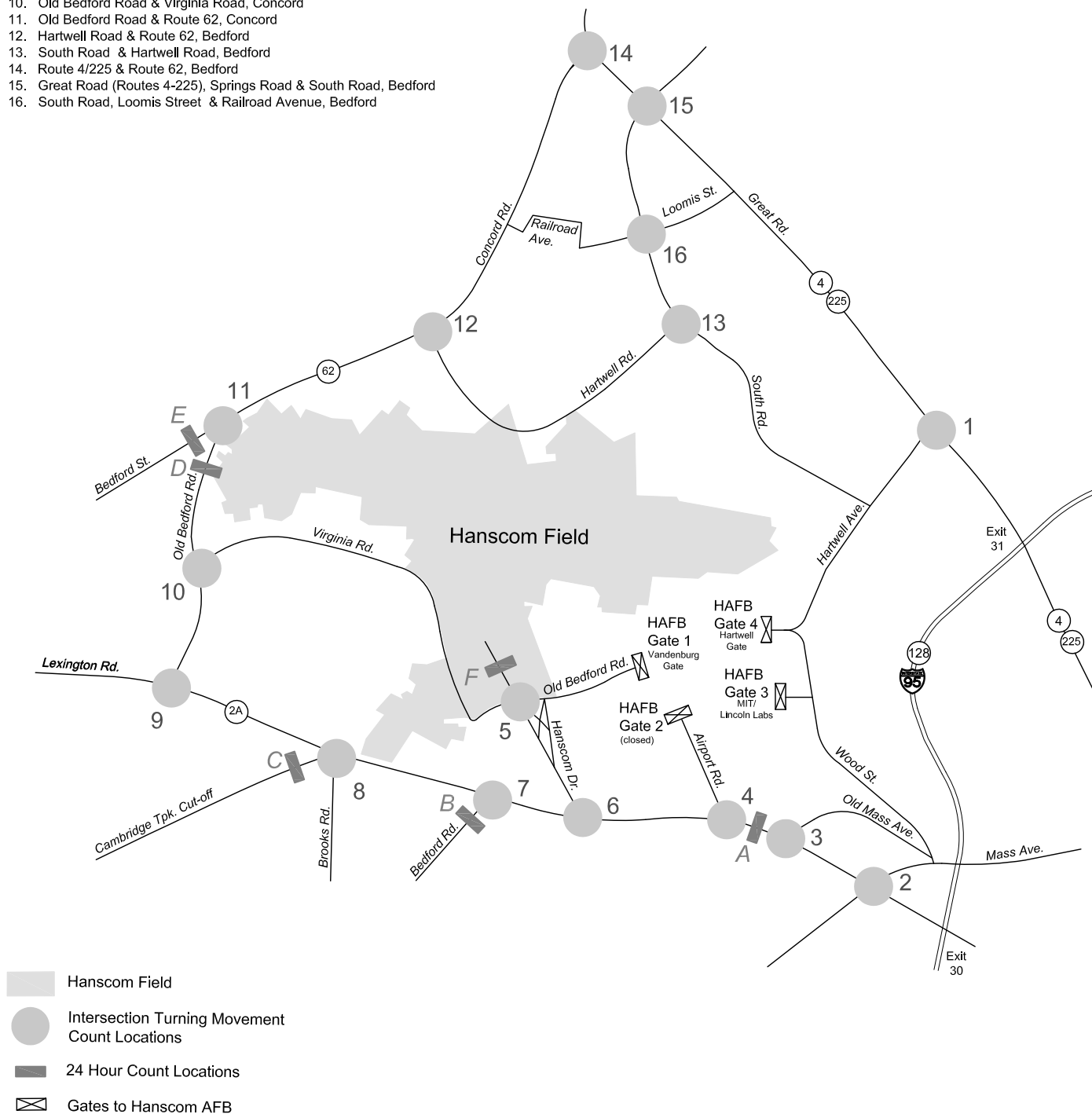
Study Intersections:

1. Route 4/225 & Hartwell Avenue (signalized), Lexington
2. Massachusetts Avenue & Route 2A, Lexington
3. Old Massachusetts Avenue & Route 2A, Lexington
4. Airport Road & Route 2A, Lexington
5. Hanscom Drive & Old Bedford Road (main Hanscom Field entrance), Lexington
6. Hanscom Drive & Route 2A, Lincoln
7. Bedford Road & Route 2A, Lincoln
8. Cambridge Turnpike Cut-Off, Brooks Road, Lexington Road & Route 2A, Lincoln/Concord
9. Old Bedford Road & Lexington Road (Route 2A), Concord
10. Old Bedford Road & Virginia Road, Concord
11. Old Bedford Road & Route 62, Concord
12. Hartwell Road & Route 62, Bedford
13. South Road & Hartwell Road, Bedford
14. Route 4/225 & Route 62, Bedford
15. Great Road (Routes 4-225), Springs Road & South Road, Bedford
16. South Road, Loomis Street & Railroad Avenue, Bedford

Daily Count Locations:

- A. Route 2A, east of Airport Road (Lexington)
- B. Bedford Road, south of Route 2A (Lincoln)
- C. Cambridge Turnpike Cutoff, southwest of Lexington Road (Lincoln, near Concord line)
- D. Old Bedford Road, north of Virginia Road (Concord)
- E. Route 62, west of Old Bedford Road (Concord)
- F. Hanscom Drive (Main Entrance of Hanscom Field), north of Old Bedford Road (Lincoln)

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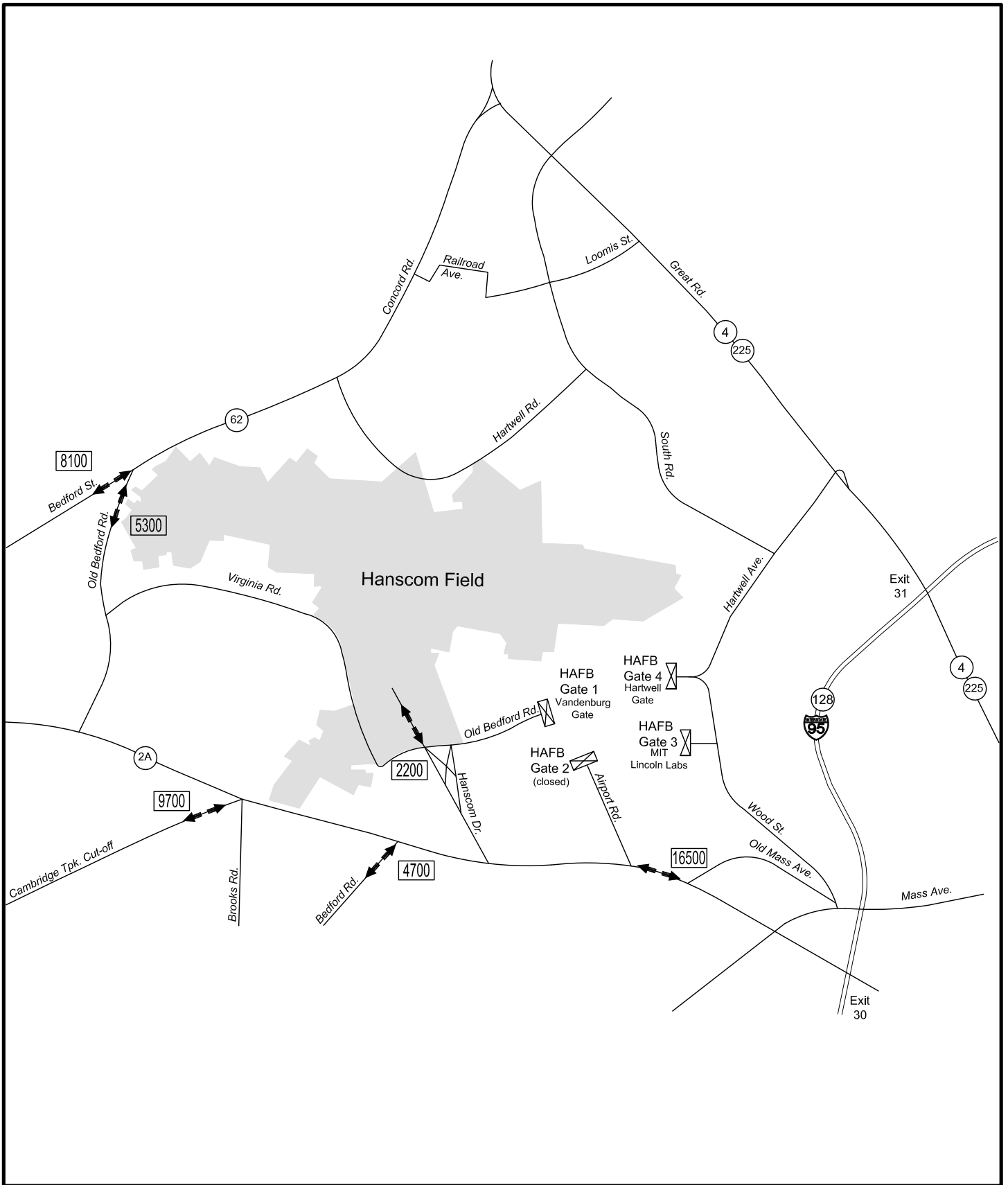
Hanscom Field 2012 ESPR

Bedford, Concord, Lexington, Lincoln, Massachusetts

**Traffic Study Area
Count Locations**

Figure 6-5

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Hanscom Field 2012 ESPR

Bedford, Concord, Lexington, Lincoln, Massachusetts

2012 Average Weekday
Traffic Volumes

Figure 6-6

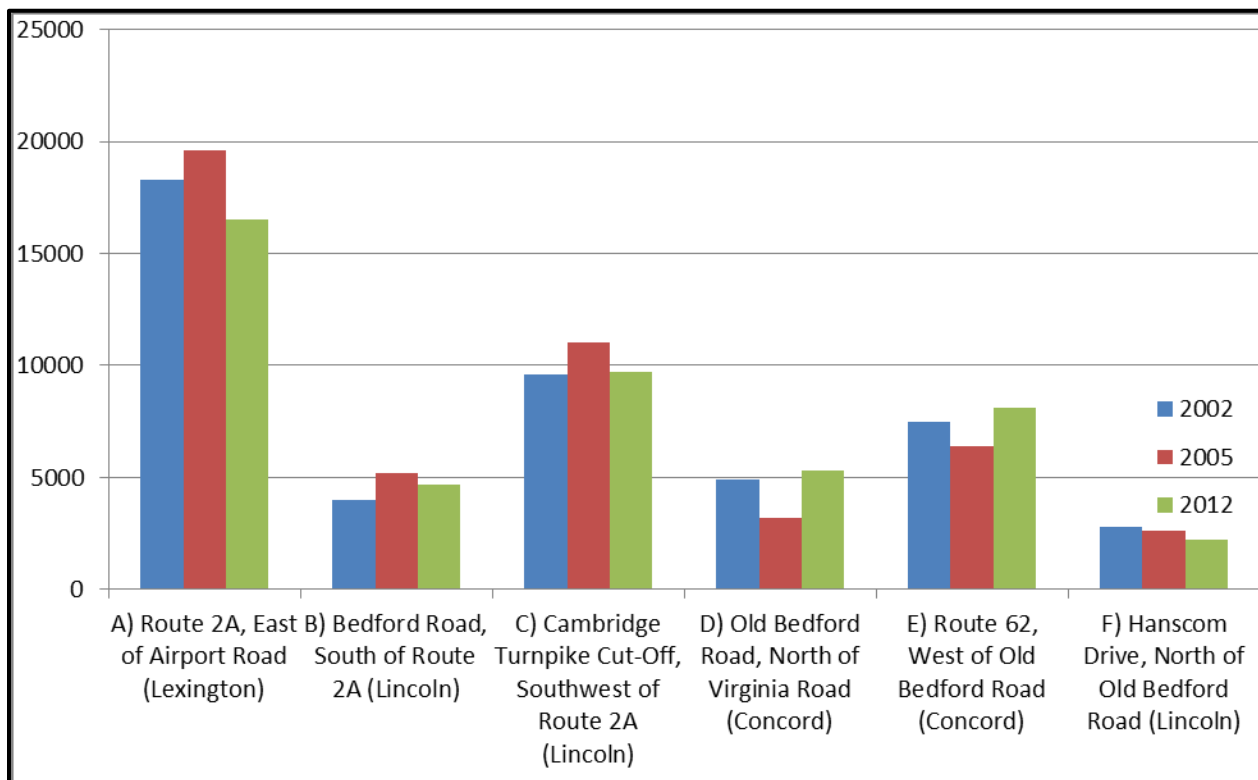


Figure 6-7 Comparison of 2002, 2005, and 2012 average weekday traffic volumes*

Source: Massport, *Hanscom Field 2005 Draft Environmental Status and Planning Report*, EOE #5484/8696 (2006) and new traffic data collected for 2012 ESPP. Refer to Figure 6-5 for locations map.

6.4.2.2 Seasonal traffic variations

The adequacy of the 2012 November traffic data was confirmed through comparisons with MassDOT counts and information from studies of Minute Man National Historical Park. MassDOT data for the most recent year indicate that traffic volumes along Route 2A (just west of Route 2, Cambridge Turnpike) in November are typically one percent lower than the average month. As indicated in Figure 6-8, visitations to the Minute Man National Historic Park vary by month. Visitation trends relate to weather conditions, length of daylight and availability of facilities. The North Bridge Visitor Center is open year-round; the Minute Man Visitors Center from April through December, the Hartwell Tavern Memorial Day through October and The Wayside is currently closed for renovations. Based on 2012 Recreational Visitor data obtained from the National Park Service Visitor Use Statistics database, visitation levels in November represent 77% of the 2012 monthly average. The “Minute Man National Park: Route 2A traffic analysis and Its Impact on the Park’s Visitor Experience” (2002) indicates that the Minute Man National Historical Park contributes 1.4% of daily traffic on Route 2A. Using the information described above, the 2012 traffic volumes were increased by a factor of 1.014, or 1.4% to account for seasonal variation from MassDOT data and the Minute Man National Historic Park.

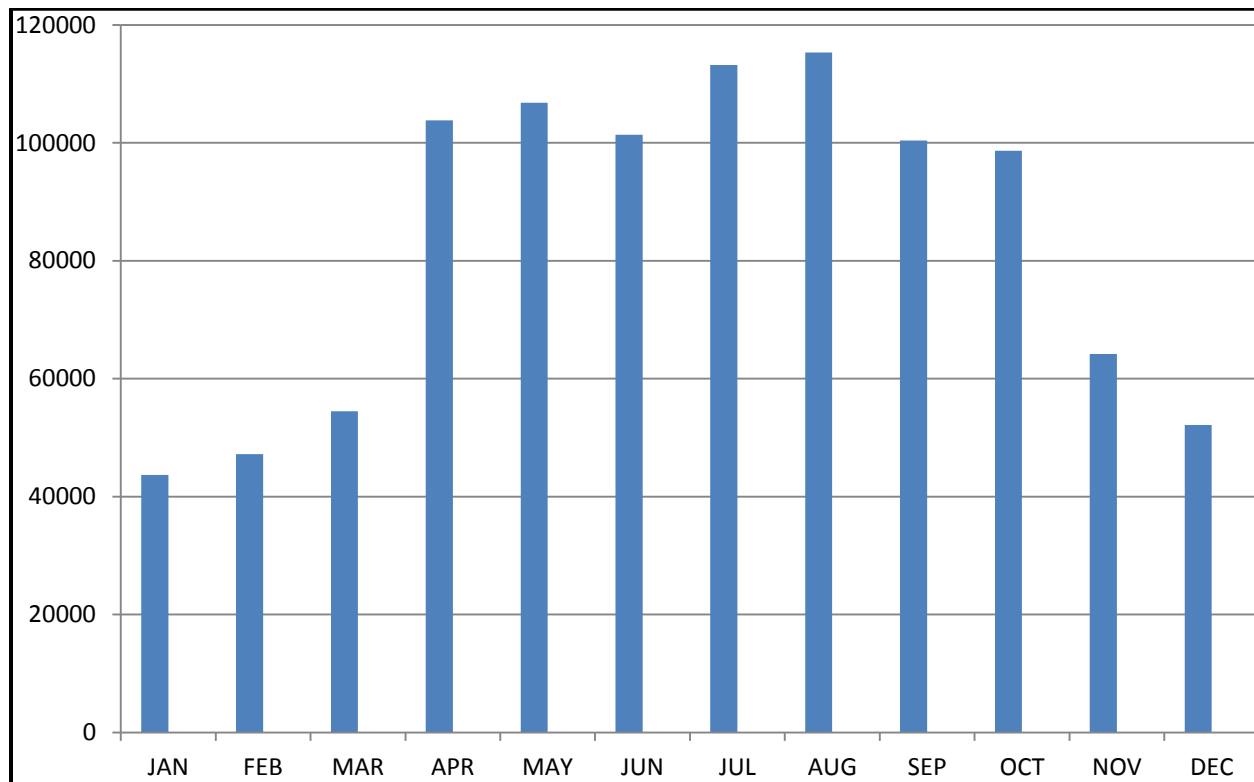


Figure 6-8 2012 Minuteman National Historical Park monthly visitations

Source: National Park Service, *Annual Recreation Visits Report: Minuteman National Historical Park*, 2013.
[http://irma.nps.gov/Stats/SSRSReports/Park Specific Reports/All Recreation?Park=MIMA](http://irma.nps.gov/Stats/SSRSReports/Park%20Specific%20Reports/All%20Recreation?Park=MIMA).

6.4.3 Study area intersections

Detailed analyses of peak hour intersection operations and traffic conditions were conducted for the roadway network illustrated in Figure 6-5 (see Figure 6-5 for intersection locations).

6.4.3.1 Intersection locations

Manual turning movement counts were collected for 16 study intersections on Wednesday, November 9 and Tuesday, November 13, 2012 from 6:00 to 9:00 a.m. and 3:00 to 6:00 p.m. This data was used with the automatic traffic count data to determine the morning and afternoon peak hours for the study area. Peak period traffic volumes were collected at the following intersections (see Figure 6-5 for locations) to create the 2012 morning and afternoon peak hour traffic networks that are a basis for this analysis:

1. Route 4-225 & Hartwell Avenue, Lexington
2. Massachusetts Avenue & Route 2A, Lexington
3. Old Massachusetts Avenue & Route 2A, Lexington
4. Airport Road & Route 2A, Lexington
5. Hanscom Drive & Old Bedford Road (main Hanscom Field entrance), Lincoln
6. Hanscom Drive & Route 2A, Lincoln
7. Bedford Road & Route 2A, Lincoln
8. Cambridge Turnpike Cut-Off, Brooks Road Lexington Road & Route 2A, Lincoln/Concord
9. Old Bedford Road & Lexington Road, Concord
10. Old Bedford Road & Virginia Road, Concord
11. Old Bedford Road & Route 62, Concord

12. Hartwell Road & Route 62, Bedford
13. South Road & Hartwell Road, Bedford
14. Route 4-225 & Route 62, Bedford
15. Great Road (Routes 4-225), Springs Road & South Road, Bedford
16. South Road, Loomis Street & Railroad Avenue, Bedford

6.4.3.2 Peak hour traffic networks

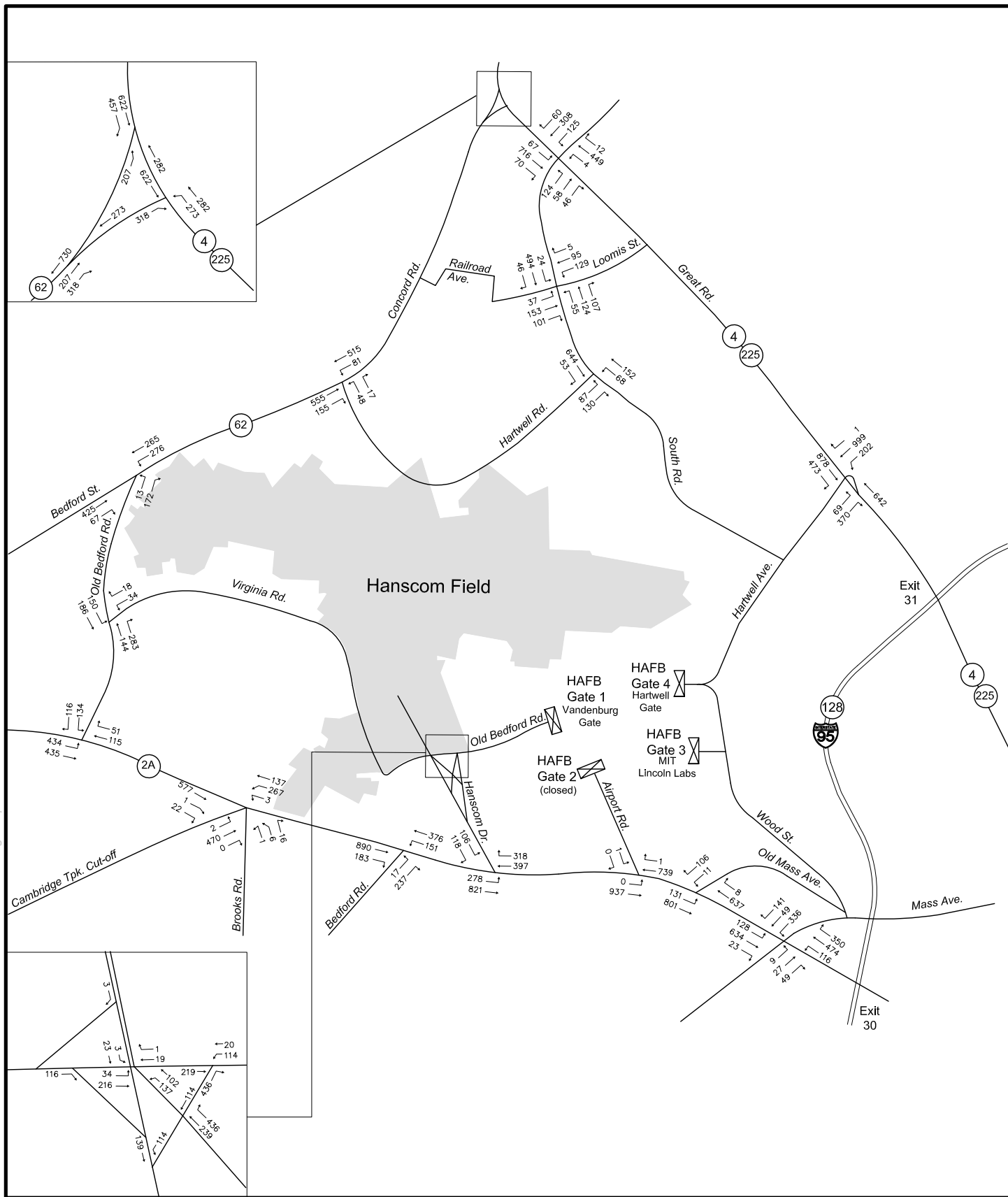
Figures 6.9 and 6.10 present the 2012 morning and afternoon peak hour volumes for the study intersections. In the morning, most of the traffic on Routes 2A, 62 and 4-225 travels eastbound to Route 128/I-95. In the afternoon, most traffic on these corridors is traveling westbound from Route 128/I-95. This primarily reflects commuting patterns from the towns to regional employment centers along and within Route 128/I-95.

Traffic flows to employment centers west of Route 128/I-95 such as Hartwell Avenue and Hanscom AFB are another consideration. Specifically, the directional split along Route 2A is more balanced east of Hanscom Drive compared to west of Hanscom Drive. For example, during the morning peak hour, traffic volumes on Route 2A east of Hanscom Drive are split 55 percent in the eastbound direction and 45 percent in the westbound direction, while west of Hanscom Drive volumes are split 70 percent in the eastbound direction and 30 percent in the westbound direction. The higher percentage of traffic traveling in a westbound direction on Route 2A near the interchange reflects the effects of employees commuting home from the area around Hanscom Field.

6.4.3.3 Hanscom Field traffic distribution

Figures 6.11 and 6.12 present the 2012 peak hour trip distribution and traffic volumes for Hanscom Field-related traffic for morning and afternoon peak hours, respectively. The existing trip distribution of Hanscom Field traffic was determined based on Hanscom main entrance directional peak hour traffic volumes and modeling of the distribution of peak hour traffic volumes at intersections within the study area.

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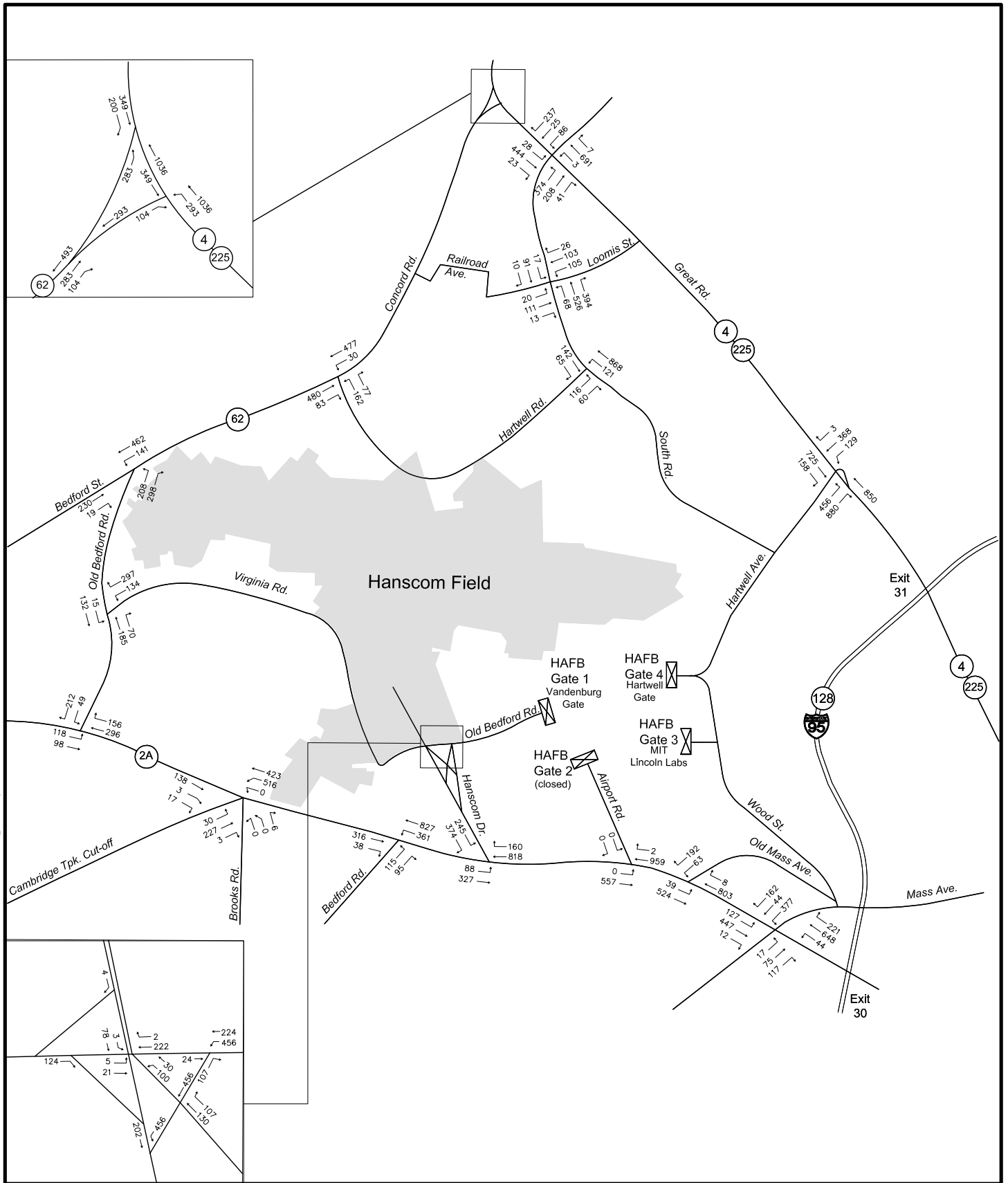
Hanscom Field 2012 ESPR

Bedford, Concord, Lexington, Lincoln, Massachusetts

2012 Morning Peak Hour
Traffic Volumes

Figure 6-9

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Hanscom Field 2012 ESPR

Bedford, Concord, Lexington, Lincoln, Massachusetts

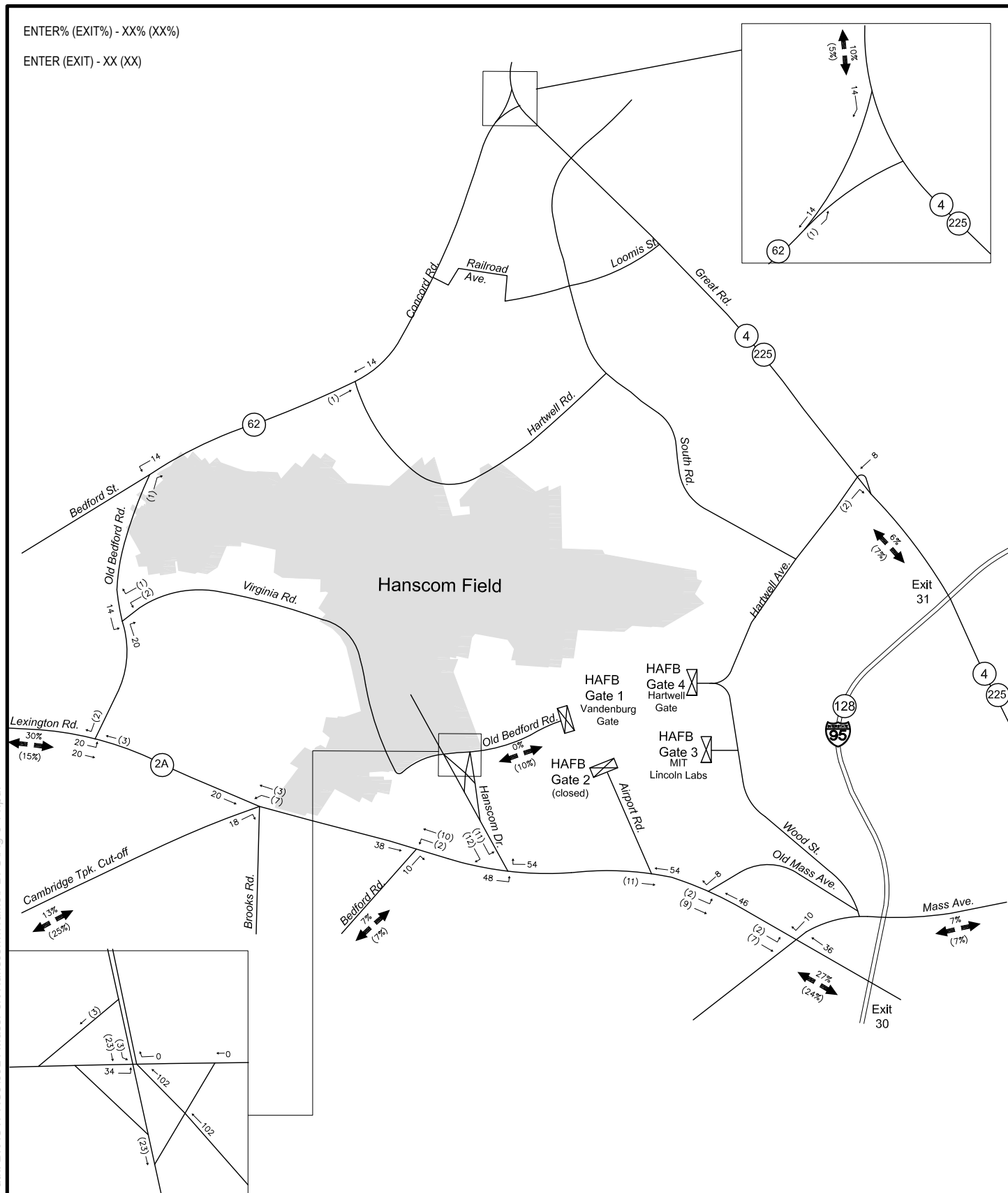
2012 Afternoon Peak Hour
Traffic Volumes

Figure 6-10

ENTER% (EXIT%) - XX% (XX%)

ENTER (EXIT) - XX (XX)

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Hanscom Field 2012 ESPR

Bedford, Concord, Lexington, Lincoln, Massachusetts

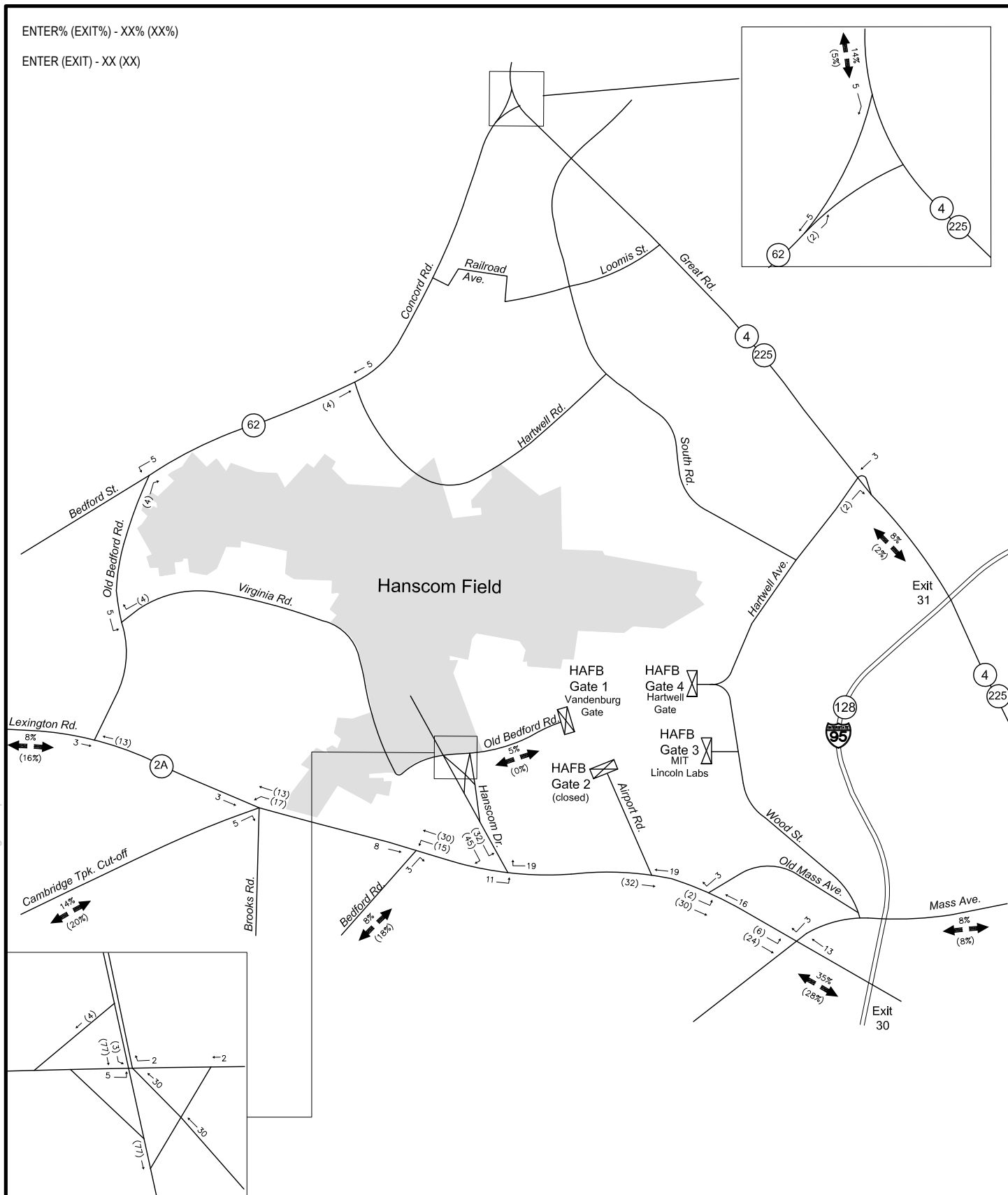
2012 Morning Peak Hour
Trip Distribution

Figure 6-11

ENTER% (EXIT%) - XX% (XX%)

ENTER (EXIT) - XX (XX)

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Hanscom Field 2012 ESPR

Bedford, Concord, Lexington, Lincoln, Massachusetts

2012 Afternoon Peak Hour
Trip Distribution

Figure 6-12

6.4.3.4 Hanscom Drive traffic volumes

Figure 6-13 illustrates the different traffic contributors on Hanscom Drive in 2012 during the morning and afternoon peak hours using data from the turning movement counts. Hanscom Field-related traffic accounts for 14 percent during the morning peak hour and 13 percent during the afternoon in 2012, as compared to 15 percent in both the morning and the afternoon peak hours for the 2005 peak periods. The drop in Hanscom's contribution reflects a decrease in traffic traveling to and from Hanscom Field due to reduced commercial air travel and reduced flight class schedule (i.e. the discontinuance of the part-time evening program since 2005). Hanscom AFB traffic is the largest component on Hanscom Drive in 2012 at 59 percent in the morning peak hour and 62 percent in the afternoon peak hour, as compared to 50 and 49% in 2005. A factor in this increase is the recent relocation of the Massachusetts National Guard to the Base.

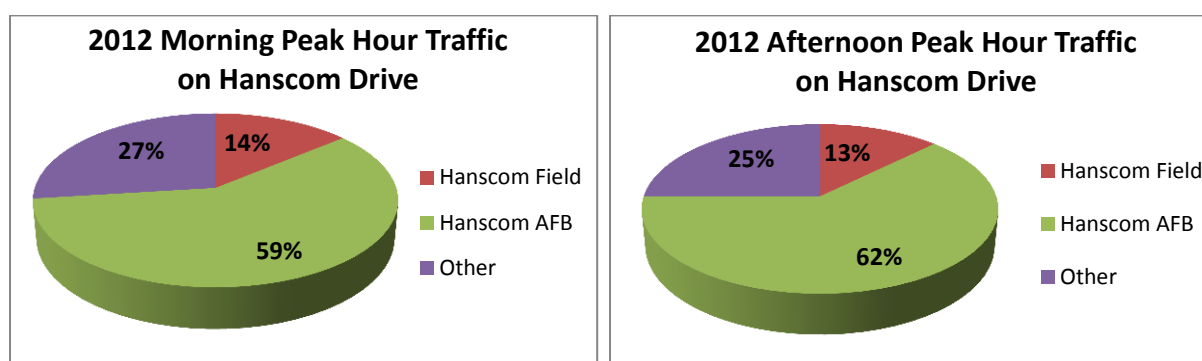


Figure 6-13 2012 Peak hour traffic on Hanscom Drive

6.4.4 Intersection screening process

MEPA has established a threshold for identifying intersections with significant impacts related to Hanscom Field. Hanscom Field traffic is considered to impact an intersection if one or more of the intersection's individual peak hour traffic movement(s) consists of ten or more percent Hanscom Field-related traffic. The traffic volumes at each of the 16 study intersections were assessed to determine which intersections had individual turning movements that met or exceeded the ten percent MEPA threshold. Table 6-5 lists the intersections that have exceeded the ten percent threshold for the four analysis years. Intersection operations were calculated for year 2012 conditions for intersections that exceeded the threshold.

Table 6-5 Intersections exceeding ten-percent threshold: 1996–2012

Intersection	Peak Hour	Analysis years			
		1996	2002	2005	2012
#5 Hanscom Drive/Old Bedford Road (Lincoln)	Morning	√	√	√	√
	Afternoon	√	√	√	√
#6 Hanscom Drive/Route 2A (Lincoln)	Morning	√	√	√	√
	Afternoon		√	√	√
#10 Old Bedford Road/Virginia Road (Concord)	Morning	√	√	√	
	Afternoon	√	√	√	√
#11 Old Bedford Road/Route 62 (Concord)	Morning				
	Afternoon			√	

Source: Massport, Hanscom Field 2005 Draft Environmental Status and Planning Report, EOE #5484/8696 (2006), see Figure 6-5 for location map.

Prior ESPRs indicate that Hanscom Field traffic accounted for more than ten percent of the traffic volume for individual movements at only three or four of the 16 intersections studied. Given this trend, it may be

feasible to study fewer intersections in future ESPRs. As shown in Table 6-5, Hanscom Field-related traffic accounted for more than ten percent of individual traffic movements at the same three intersections in 1996, 2002, 2005 and 2012. Additionally, the afternoon peak hour Hanscom Field traffic volumes in 2005 accounted for more than ten percent of traffic movements on the left-turn from Route 62 to Old Bedford Road in the intersection of Old Bedford Road and Route 62.

6.4.5 Analysis of intersection operations

This section provides level of service calculations, volume-to-capacity ratios and seconds delay at the screened intersections. Appendix C provides the level of service calculation sheets.

6.4.5.1 Level of service

The performance of the study intersections was analyzed in SYNCHRO 7.0 and measured using Levels of Service (LOS), which is determined based on the process specified in the 2000 Highway Capacity Manual (HCM). Levels of Service range from 'A' to 'F' where LOS 'A' represents optimal conditions with fewer than 10 seconds of delay, while 'F' represents failing conditions where delay exceeds 50 seconds at unsignalized intersections or 80 seconds at signalized intersections. Table 6-6 shows the delay thresholds for LOS at signalized and unsignalized intersections based on the 2000 HCM.

Table 6-6 Intersection level of service criteria

LOS	Average delay per vehicle (seconds)	
	Signalized intersections	Unsignalized intersections
A	<10.0	<10.0
B	10.1 to 20.0	10.1 to 15.0
C	20.1 to 35.0	15.1 to 25.0
D	35.1 to 55.0	25.1 to 35.0
E	55.1 to 80.0	35.1 to 50.0
F	>80.0	>50.0

LOS for signalized intersections is based on the average delay experienced by motorists traveling through the intersection. Delay is based on capacity analysis and other variables such as quality of signal progression, cycle length, and ratio of green time. LOS for two-way stop-controlled intersections is based on delay as a function of capacity of the approach and degree of saturation. LOS is determined for motorists entering from the minor road or turning left from the major road, movements in which motorists must use judgment to select an adequate gap in conflicting traffic. The performance of the study intersections was also measured by 95th percentile queue length; that is the queue length in feet with only a 5% probability of being exceeded during the time period, particularly at locations where queues from one intersection could impact another nearby intersection.

6.4.5.2 Existing Intersection Operations

The procedures described above were used to determine existing weekday peak hour operating LOS at the study intersections where Hanscom Field traffic represented more than ten percent of any traffic movement. Tables 6.7 and 6.8 summarize the 2012 peak hour traffic operations for these intersections. Detailed traffic capacity analysis reports are included in Appendix C.

At the intersection of Hanscom Drive and Route 2A, the analysis indicates that southbound Hanscom Drive experiences significant delays during both the morning and afternoon peak hours. However, it appears that the analysis is not accurately representing actual operating conditions. Based on observations at the intersection, there are several unique behaviors occurring at this intersection requiring

additional interpretation. First, motorists are offering other motorists “courtesy gaps”. For example, motorists on Route 2A were observed stopping to allow motorist to turn left from Hanscom Drive onto Route 2A. Additionally, westbound motorists on Route 2A were observed stopping to allow motorists on Route 2A to turn left onto to Hanscom Drive. Second, motorists in both the left turn lane and right turn lane were doing “rolling stops”, or not stopping fully before going through the intersection. Both these factors result in Synchro over estimating the delay and queues at this intersection. Furthermore, due to the wait that sometimes occurs for left-turning vehicles on Hanscom Drive, a few vehicles were observed taking “risky” turns, or turns during a gap in vehicles that is smaller than considered safe. At the current volumes, this intersection meets the peak-hour threshold for a traffic signal according to Figure 4C-4 of the 2009 Manual of Uniform Traffic Control Devices.

Table 6-7 (SYNCHRO) at screened intersections: morning peak hour

Refer to Figure 6-5 for locations map.

Intersection	Weekday morning peak hour		
	LOS	Delay	v/c
#5 Hanscom Drive/Old Bedford Road			
Hanscom Dr NB LT	A	4.3	0.1
Hanscom Dr SB LT	A	0.6	0
Old Bedford Rd EB LT	C	19.1	3.5
Old Bedford Rd EB T	C	20.1	4.0
Old Bedford Rd WB LT	B	14.2	0.05
Old Bedford Rd EB T	B	13.2	0.03
#6 Hanscom Drive/Road 2A			
Rt. 2A EB L	A	9.6	0.29
Hanscom Dr. SB L	F	>200	3.69
Hanscom Dr. SB R	C	16.7	0.34

Table 6-8 (SYNCHRO) at screened intersections: afternoon peak hour

Refer to Figure 6-5 for locations map.

Intersection	Weekday afternoon peak hour		
	LOS	Delay	v/c
#5 Hanscom Drive/Old Bedford Road			
Hanscom Dr NB LT	A	1.7	0.02
Hanscom Dr SB LT	A	0.3	0
Old Bedford Rd EB LT	B	13.7	0.04
Old Bedford Rd EB T	B	11	0.0
Old Bedford Rd WB LT	B	13.6	0.32
Old Bedford Rd EB T	B	11.9	0.16
#6 Hanscom Drive/Road 2A			
Rt. 2A EB L	B	10.3	0.13
Hanscom Dr. SB L	F	>200	2.68
Hanscom Dr. SB R	F	>200	1.41
#10 Old Bedford Road/Virginia Road			
Virginia Road WB LR	D	27.3	0.78
Old Bedford Road SB LT	A	1.1	0.02

6.4.6 Traffic Safety

The crash history of the three screened study intersections, which are located in MassDOT District 4, were evaluated to identify safety deficiencies and determine if any location experiences a higher than average annual crash rate. The crash data was obtained from MassDOT’s Highway Division for the five

most recent years available (2006-2010) and is contained in Appendix C. The safety data are summarized in Table 6-9.

The MassDOT Crash Rate Worksheet was used to determine whether the crash frequencies at the three screened study intersections were higher than other intersections. The MassDOT Crash Rate Worksheet calculates a crash rate expressed in crashes per million entering vehicles. The calculated rate is then compared to the average crash rates for signalized and unsignalized intersections statewide and within the MassDOT District. The statewide rates are 0.60 for unsignalized intersection and 0.80 for signalized intersections. The MassDOT District 4 crash rates are 0.58 crashes per million entering vehicles for unsignalized intersections and 0.77 crashes per million entering vehicles for signalized intersections. The MassDOT Crash Rate Worksheets for each study intersection are provided in Appendix C.

Twenty-one crashes were reported at the three screened unsignalized intersections from 2006 to 2010. Approximately 33% of the crashes involved personal injury. No fatalities were reported at the screened intersections during the time period evaluated. Angled crashes, rear-end crashes and single vehicle crashes each were approximately 30% of the crashes at the intersections. The 17 crashes at Hanscom Drive/Route 2A (Lincoln) ranked highest among the three screened intersections, or an average of 3.4 crashes per year, which is lower than an average 6.4 crashes per year as reported in the *2005 ESPR*. The crash rate at this intersection was lower than the statewide and district-wide averages for unsignalized intersections. The most common type of crash at this intersection was a rear-end collision (41 percent). A crash at the intersection of Old Bedford Road/Virginia Road (Concord) involved a bicyclist.

Table 6-9 Crash summary: 2005 – 2010

	#5) Hanscom Drive/ Old Bedford Road (Lincoln)	#6) Hanscom Drive/ Route 2A (Lincoln)	#10) Old Bedford Road/Virginia Road (Concord)
Traffic Control:	Unsignalized	Unsignalized	Unsignalized
Year			
2006	0	1	0
2007	0	5	1
2008	0	3	0
2009	2	6	0
2010	0	2	1
Total	2	17	2
Type			
Angle	2	5	1
Rear-End	0	7	0
Head-on	0	0	1
Sideswipe	0	1	0
Single Vehicle	0	4	0
Total	2	17	2
Severity			
Property Damage Only	1	12	1
Personal Injury	1	5	1
Fatality	0	0	0
Other	0	0	0
Total	2	17	2
Weather			
Clear	1	13	2
Cloudy	1	2	0
Rain	0	2	0
Snow	0	0	0

	#5) Hanscom Drive/ Old Bedford Road (Lincoln)	#6) Hanscom Drive/ Route 2A (Lincoln)	#10) Old Bedford Road/Virginia Road (Concord)
Unknown/Other	0	0	0
Total	2	17	2
Time			
7:00 a.m. to 9:00 a.m.	0	1	0
9:00 a.m. to 4:00 p.m.	2	6	1
4:00 p.m. to 6:00 p.m.	0	8	0
6:00 p.m. to 7:00 a.m.	0	2	1
Total	2	17	2
State Wide Rate	0.60	0.60	0.60
District Wide Rate	0.58	0.58	0.58
Intersection Rate	0.09	0.45	0.14

Source: Massachusetts Department of Transportation, MassHighway Crash Data Worksheet.

6.5 Analysis of Future Scenarios

This section describes the background assumptions and methodology used to evaluate future roadway and volume conditions within the study area for the 2020 and 2030 scenarios. The 2012 *ESPR* future scenarios are used to evaluate the potential cumulative environmental effects that could occur if Hanscom Field reaches the airport activity levels that are described in Chapter 3, Airport Activity Levels. The 2020 and 2030 scenarios represent estimates of what could occur (not what will occur) in the future using certain planning assumptions and are not necessarily recommended outcomes.

Future increases in weekday peak hour vehicular traffic were estimated for the 2020 and 2030 scenarios and were added to the study area roadway network to evaluate their effects. The potential vehicular traffic volume increases include vehicle trips generated by assumed future background growth, specific planned non-Hanscom developments in the area reported by the towns, as well as forecast growth at Hanscom Field. In addition to the components of future traffic growth, this section describes planned roadway improvements in the area and their expected effects on the transportation network.

The analysis identified traffic increases on key roadways such as Route 2A and conducted LOS analysis for study area intersections where Hanscom Field traffic represents ten percent or more for any traffic movement, as required by MEPA.

6.5.1 Future background growth

Future growth in traffic volumes occurs because of regional background growth and the traffic associated with specific plans/developments in the individual towns. This section describes background growth trends and planned developments within the towns of Bedford, Concord, Lexington, and Lincoln.

6.5.1.1 Regional background growth

In order to determine a background growth rate for traffic volumes in the study area, the following sources were consulted:

- When comparing 2005 ATR counts with 2012 ATR counts, the traffic volumes along Route 2A, Bedford Road and Cambridge Turnpike Cutoff have decreased (approximately 1-2% per year). Traffic volumes along Route 62 and Old Bedford Road increased; however, the majority of this increase can be attributed to the former Raytheon facility on Hartwell Road being taken over and

occupied by Instrumentation Labs which likely resulted in increased traffic volumes along both Route 62 and Old Bedford Road.

- MAPC produced population and employment projections to support the development of *Paths to a Sustainable Region*, the Boston MPO's long range transportation plan. The projections estimate that population and employment will have limited growth (less than 0.5% per year) through 2030.
- A MassDOT traffic count on Route 2A west of Cambridge Turnpike showed a modest increase (less than 0.5% per year) in traffic volume between 2011 and 2012.

Based on these three sources, a growth rate of 0.5% per year, compounded annually, was used to account for background growth in traffic volume for both the 2020 and 2030 forecast years.

6.5.1.2 Planned and potential future developments

Planning officials from Bedford, Concord, Lexington, and Lincoln were contacted to identify specific proposed or planned development projects within those towns that could potentially impact traffic volumes in the vicinity of Hanscom Field. These projects include planned projects as well as potential projects that might be built in the future.

Table 6-10 lists the specific background developments that are included in the analysis of the 2020 and 2030 scenarios. Estimated traffic volumes generated by specific proposed projects in Table 6-10 were added to the study intersections.

Table 6-10 Planned development projects

Project	Description	Status	2020	2030
Town of Bedford				
Café at the Red Barn	Restaurant in Depot Park	On hold		
54 Loomis St.	Mixed-use development (19 condos and 2,860 sq.ft. retail)	Approved	√	√
Blake Block	Mixed-use development (7 condos and 26,000 sq. ft. retail)	Under Construction	√	√
Town of Concord				
506 Old Bedford Road	8-unit Planned Residential Development	Under Construction	√	√
Monsen Road	8-lot subdivision	Under Construction	√	√
Town of Lexington				
113 Hartwell Avenue	Medical Marijuana Treatment Center	Proposed	√	√

In the Town of Bedford, the Café at the Red Barn is currently on hold so this development was not included in future forecasts. 54 Loomis Street and Blake Block are two mixed-used developments in the Town of Bedford included in both the 2020 and 2030 forecast years. Given the size of the proposed development at 54 Loomis Street, this development was assumed to be captured in the background growth. For the Blake Block project that is currently under construction, specific trips were generated and assigned to the study intersections. The Town of Concord has two small residential developments under construction (i.e. 506 Old Bedford Road and Monsen Road), which were assumed to be captured in the background growth. The Town of Lexington has a Medical Marijuana Treatment Center proposed at 113 Hartwell. Specific trips were generated and assigned for this development to the study intersections, which were included in both the 2020 and 2030 forecast years.

6.5.1.3 Special generators

Additional special generators were considered that include Hanscom AFB and the Minute Man National Historical Park. The additional vehicle trips associated with these special generators were included in the future background growth as described below.

- The Hanscom AFB borders the southeast side of Hanscom Field. Between the 2005 *ESPR* and the 2012 *ESPR*, the Massachusetts National Guard Joint Force Headquarters opened at the Base and the Air Force Research Laboratory left the Base, resulting in a considerable area of vacant property. There are plans for MIT Lincoln Labs to take over and occupy up to 300,000 square feet of the space vacated by the Air Force Research Laboratory. Specific trips were generated and assigned for this development to the study intersections, which were included in both the 2020 and 2030 forecast years. Hanscom AFB has three operating gated entrances (see Figure 6-5). The Vandenberg Gate (Gate 1) is located at Vandenberg Drive east of the intersection of Hanscom Drive/Old Bedford Road, which serves traffic to and from Route 2A. Gate 2 is no longer being used. Gate 3 located on Wood Street provides direct access to the Lincoln Laboratory via Route 4-225 or Route 2A. Gate 4 is located at Barksdale Street/Hartwell Avenue and serves traffic to and from Routes 4-225 via Hartwell Avenue. The trip distribution for the MIT Lincoln Labs expansion assumed that approximately half of motorists would access the Hanscom AFB via the Vandenberg Gate (Gate 1) and the other half would travel to/from the Base via either Gate 3 or Gate 4.
- Much of the Minute Man National Historical Park runs parallel to Route 2A (Battle Road) south of Hanscom Field. The Minute Man National Historical Park attracts about one million visitors per year. The April 2005 *Minute Man Alternative Transportation Evaluation* indicates that few visitations occur during the peak commuting times. Additionally, the records of recreation visitors from the National Park Service Visitor Use Statistics database indicate that the number of yearly visitors has been consistent the last five years. Therefore, the analysis in the 2012 *ESPR* does not include any specific trips for the park and assumes that the future peak hour traffic growth from Minute Man National Historical Park is accounted for in the background growth rate of 0.5 percent per year.

6.5.2 Hanscom Field traffic projections

To assess the future traffic impacts of Hanscom Field, trips generated by possible future activity at Hanscom Field for the 2020 and 2030 forecasts were estimated. Vehicular traffic at Hanscom Field is generated by both general and commercial aviation activities, and other airport-related land uses. General aviation (GA) includes flights for training, personal use, and business/corporate use. In 2012, GA accounted for most (99%) of the civilian operations with the remaining being commercial air passenger services. In 2005, civilian operations were 97% GA and 3% commercial. Future growth estimates for airside operations (GA, commercial aviation, and light cargo operations) were based on aviation forecasts presented in Chapter 3, Airport Activity Levels. Future growth based on these forecasts was applied to existing peak hour activity levels at Hanscom Field to estimate the number of new weekday morning and afternoon vehicular trips generated by aviation activities under each of the two future scenarios. Ground-side trip generation for other land uses at Hanscom Field was estimated based on standard Institute of Transportation Engineers (ITE) trip rates.

Table 6-11 shows vehicle trip generation for 2012 and the 2020 and 2030 scenarios. In general, the 2012 *ESPR* Hanscom Field trip generation is similar to the 2010 and 2020 Moderate Growth scenario from the

2005 *ESPR* and lower than the 2010 and 2020 High Growth scenarios. These differences reflect reduced forecasts for GA and commercial activity and increases in airport-related land uses. Trip generation characteristics of GA, commercial aviation, based cargo operations, and other airport-related land uses are described below. Detailed trip generation summaries are provided in Appendix C.

Table 6-11 Hanscom Field Trip Generation for 2020 and 2030 Scenarios

Intersection	Morning peak hour			Afternoon peak hour		
	In	Out	Total	In	Out	Total
2012	136	29	165	37	84	121
2020 Forecast	178	42	220	46	120	166
2030 Forecast	291	99	390	122	223	345

6.5.2.1 General Aviation

GA includes single engine local flights for training; single engine piston itinerant for personal flying; single, twin, turbo and jet operations for business and corporate use; and helicopters for personal and business uses. Vehicle trips associated with GA were estimated using information from the “Hanscom Trip Generation Model” developed in the 2005 *ESPR* and future growth in GA operations as presented in Chapter 3, Airport Activity Levels. There are modest increases in GA operations anticipated (i.e. 1% growth between 2012 and 2020 and 14% growth between 2020 and 2030). The results of the 2020 and 2030 scenarios indicate that future GA operations could result in up to nine new morning peak hour vehicular trips and up to 11 new afternoon peak hour vehicular trips.

6.5.2.2 Commercial operations

Commercial aviation at Hanscom Field includes all commercial passenger flights. For each future scenario, the forecasted number of commercial passengers from Chapter 3, Airport Activity Levels was used to estimate the number of vehicle trips during the morning and afternoon peak hours. Since there was no commercial activity at the time of the 2012 intersection turning movement counts, 2005 peak hour trips and the number of commercial passengers in 2005 were used to estimate the number of peak hour trips for the 2020 and 2030 scenarios. The results of the 2020 and 2030 scenarios indicate that future commercial operations could result in 12 to 22 new morning peak hour vehicular trips and six to 11 new afternoon peak hour vehicular trips. These trip estimates are lower than the forecast trips from the 2005 *ESPR* given the reductions in forecasts for potential commercial activity.

6.5.2.3 Cargo operation

There are no traditional cargo operations included in the 2020 or 2030 Forecasts.

6.5.2.4 Airport-related land use

Other airport-related traffic generators at Hanscom Field include the National Aviation Academy (NAA), a potential hotel and the proposed Massachusetts Air and Space Museum.

- Based on conversations with staff from the NAA, there are currently no specific plans for expanding the student body. Current daytime classes begin at 7:30 a.m. and end at 3:30 p.m. so students typically arrive and depart outside the peak hours at the study intersections. NAA has held nighttime classes in the past and staff is interested in offering those classes if there is interest from students. Nighttime students arrive before the afternoon peak hour and depart after the afternoon peak hour. Therefore, no additional vehicle trips were assumed for the NAA.

- The trip generation for a potential hotel is based on the Hotel land use (LU #310) from the Institute of Transportation Engineer's (ITE) Trip Generation Manual, 9th Edition. It assumes that the 200-room hotel will be operational by 2030 and that 5% of all trips to the hotel are internal trips from Hanscom Air Field (i.e. 5% would arrive/depart by plane).
- The Massachusetts Air and Space Museum representatives continue to work on fundraising efforts for a future museum at Hanscom Field. The museum trip generation assumes that half of the museum's 161,000 square feet will open by 2020 and the remaining half will open by 2030. The ITE Trip Generation Manual only provides data for one museum of 45,000 square feet in Tennessee, so the trip generation rates from this site were averaged with those from a 2008 study of a California museum of 69,500 square feet. (Source: "Draft Environmental Impact Report for the Museum of Tolerance Project")

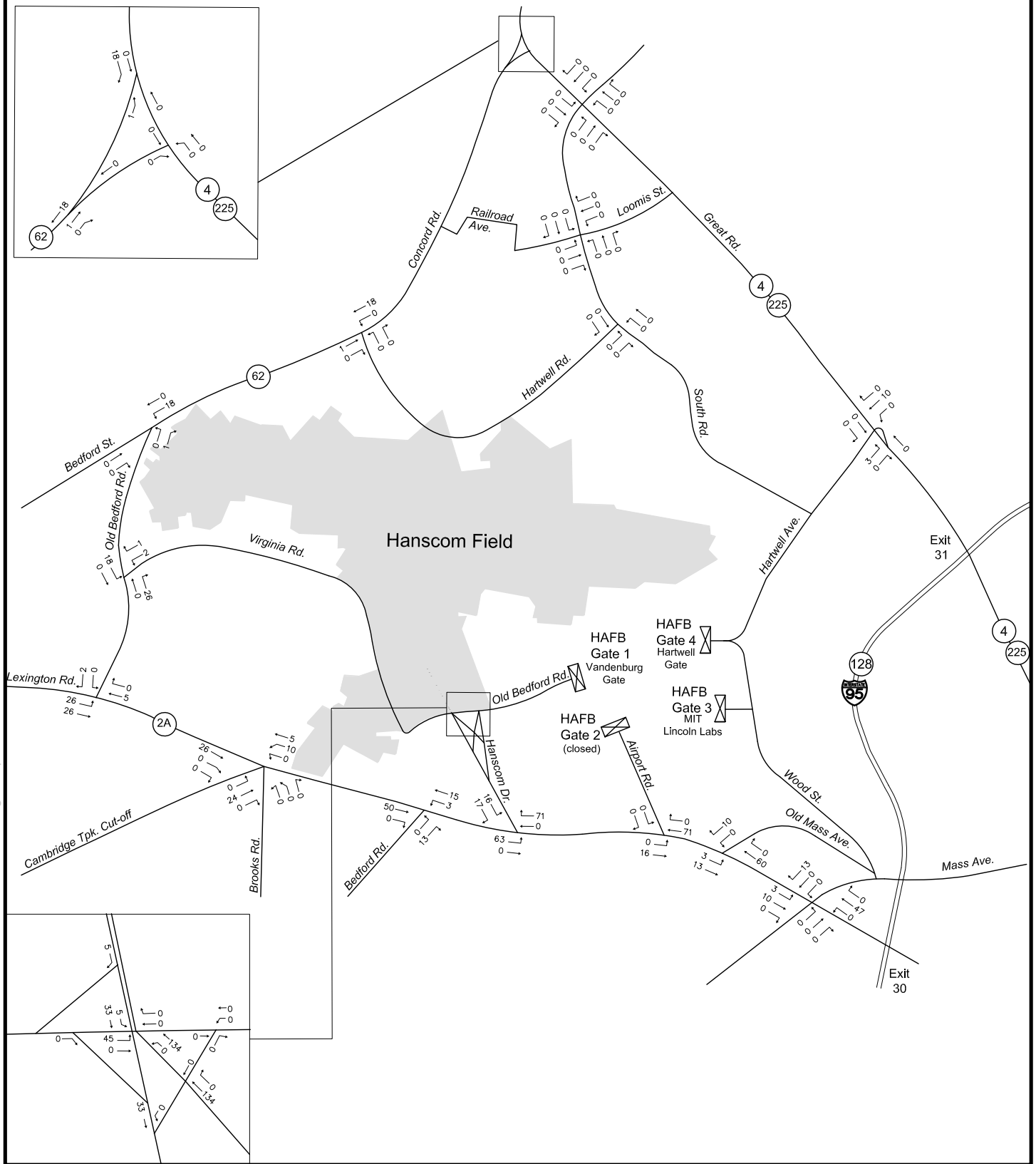
6.5.2.5 Hanscom Field trip distribution

Anticipated vehicular traffic volume increases due to future background growth, specific proposed or planned developments in the area, and future changes at Hanscom Field were added to the existing peak hour traffic volume to estimate future peak hour traffic volumes for the 2020 and 2030 forecast scenarios. Trips to and from Hanscom Field were distributed based on existing trip distribution patterns. The following entrance locations were also considered:

- On the south side of the site, the existing main entrance to the terminal area on Hanscom Drive would continue to be used under all future scenarios as the primary access.
- Virginia Road will be used to access the new Rectrix hangar.
- Access to the north side of Hanscom Field (North Airfield and the Navy Parcel) is assumed to occur from South Road and Hartwell Road. These entrances would be available for access to potential GA hangars, buildings and T-hangars identified in the growth scenarios for the north area of the site.

The number of vehicle trips to/from Rectrix, North Airfield Area and the Navy Parcel will be minimal during the morning and afternoon peak hours. As such, all vehicle trips are assumed to travel to/from Hanscom Field via the main entrance on Hanscom Drive. Figures 6.14 through 6.17 present the 2020 and 2030 forecast volumes for Hanscom Field Traffic Only. Figures 6.18 through 6.21 present the 2020 and 2030 forecast volumes including background growth, proposed or planned developments and Hanscom Field traffic.

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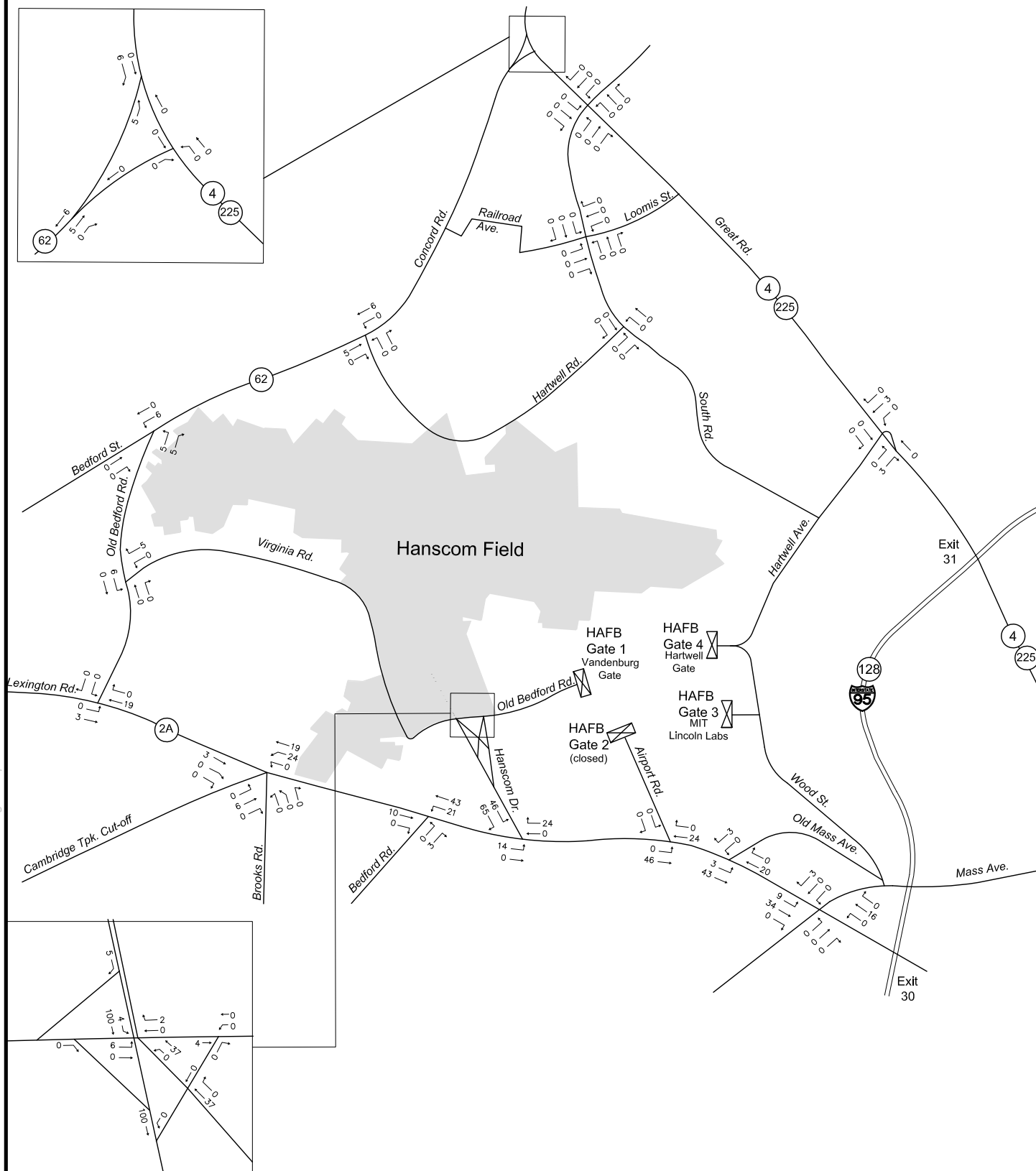


Hanscom Field 2012 ESPR

Bedford, Concord, Lexington, Lincoln, Massachusetts

2020 Morning Peak Hour
Traffic Volumes (Hanscom Field Only)

Figure 6-14



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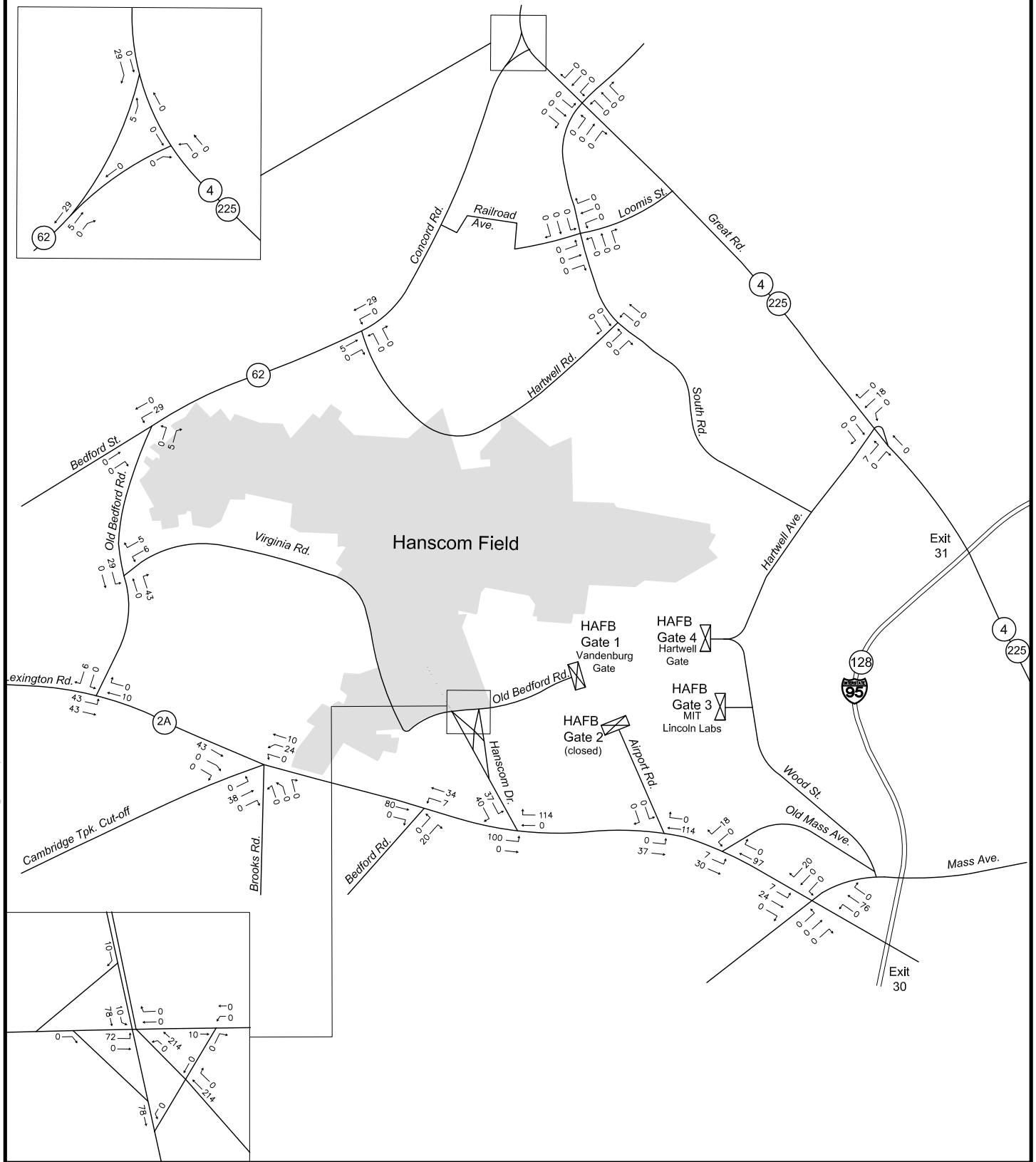
Hanscom Field 2012 ESPR

Bedford, Concord, Lexington, Lincoln, Massachusetts

2020 Afternoon Peak Hour
Traffic Volumes (Hanscom Field Only)

Figure 6-15

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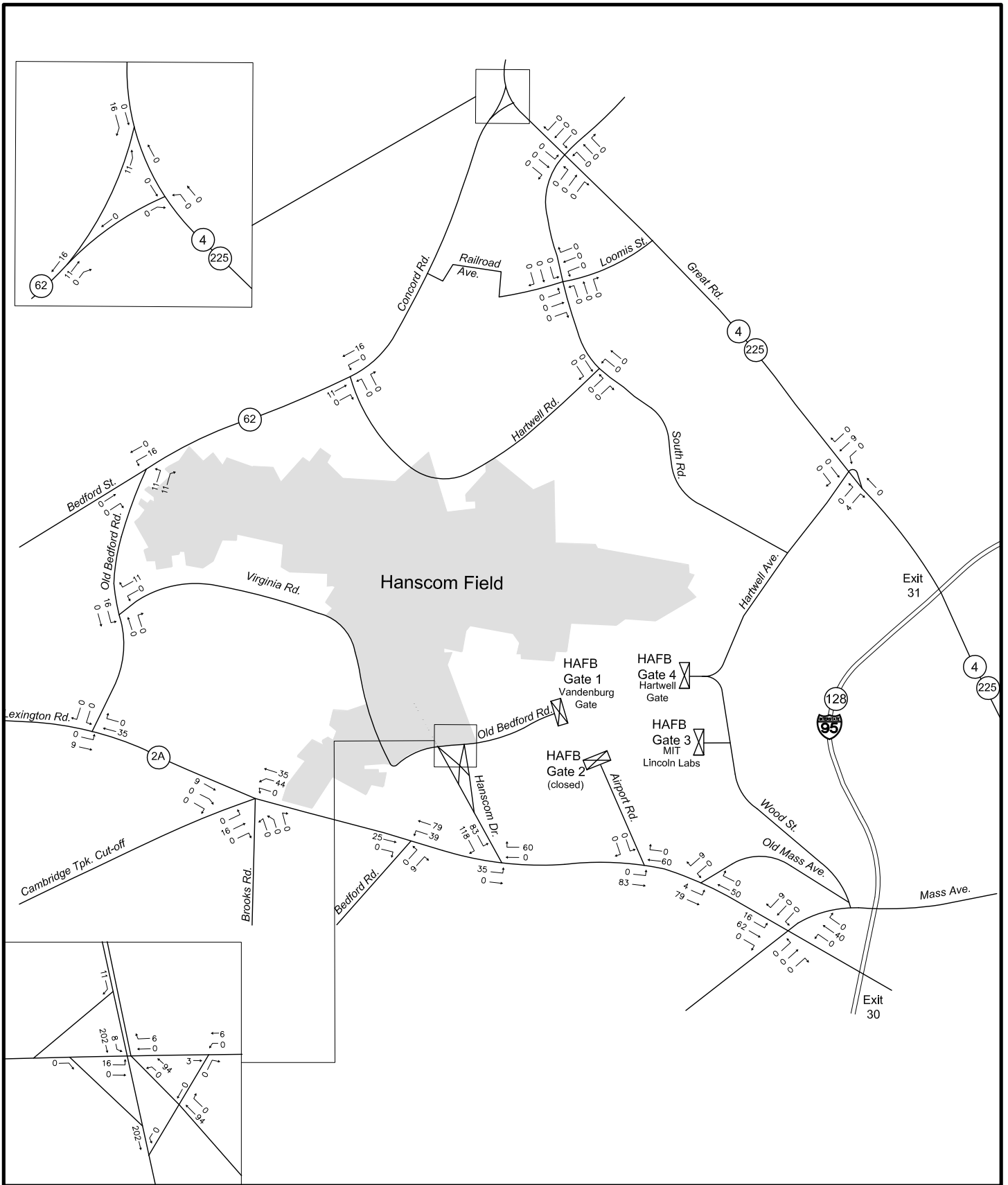
Hanscom Field 2012 ESPR

Bedford, Concord, Lexington, Lincoln, Massachusetts

2030 Morning Peak Hour
Traffic Volumes (Hanscom Field Only)

Figure 6-16

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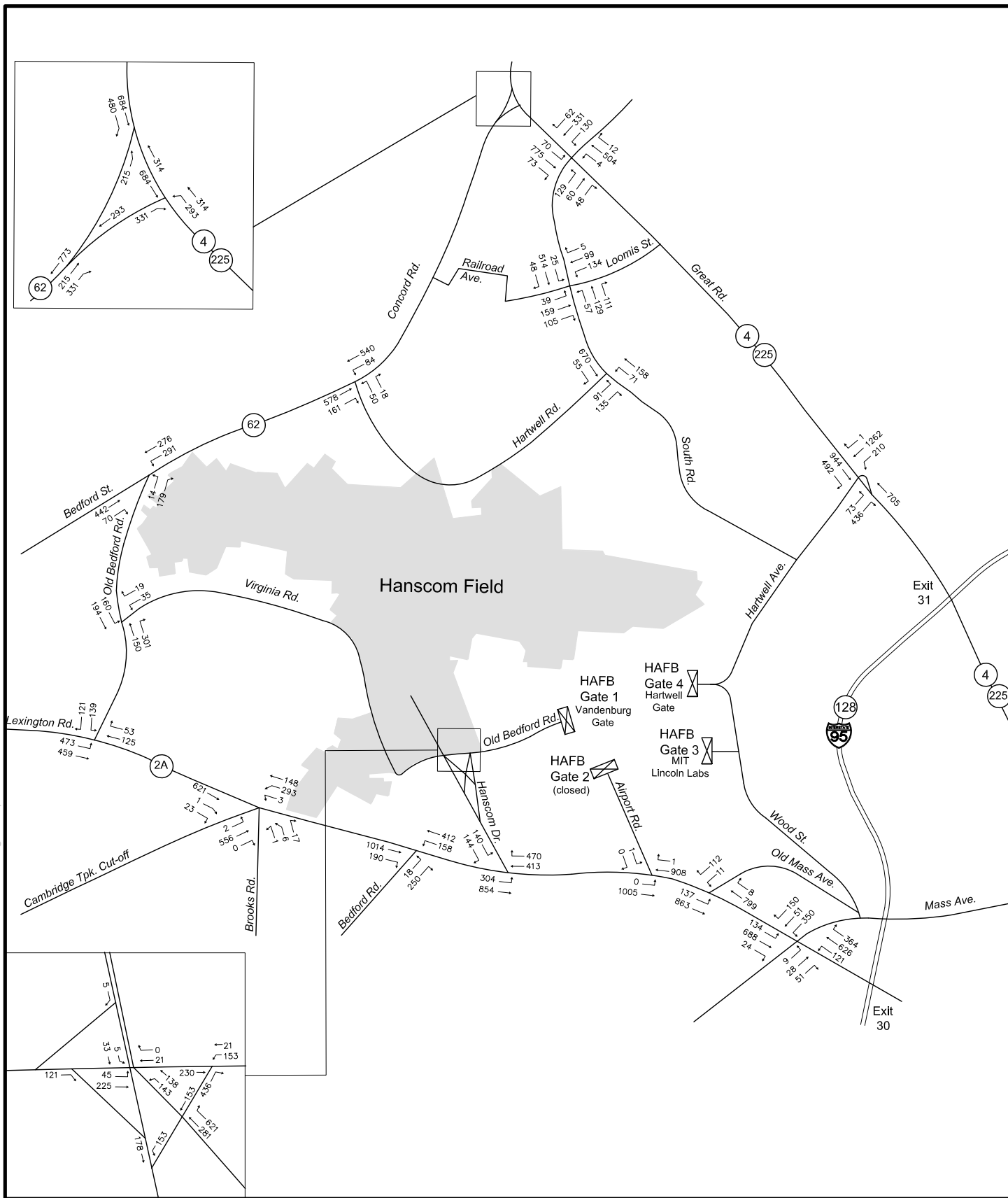
Hanscom Field 2012 ESPR

Bedford, Concord, Lexington, Lincoln, Massachusetts

2030 Afternoon Peak Hour
Traffic Volumes (Hanscom Field Only)

Figure 6-17

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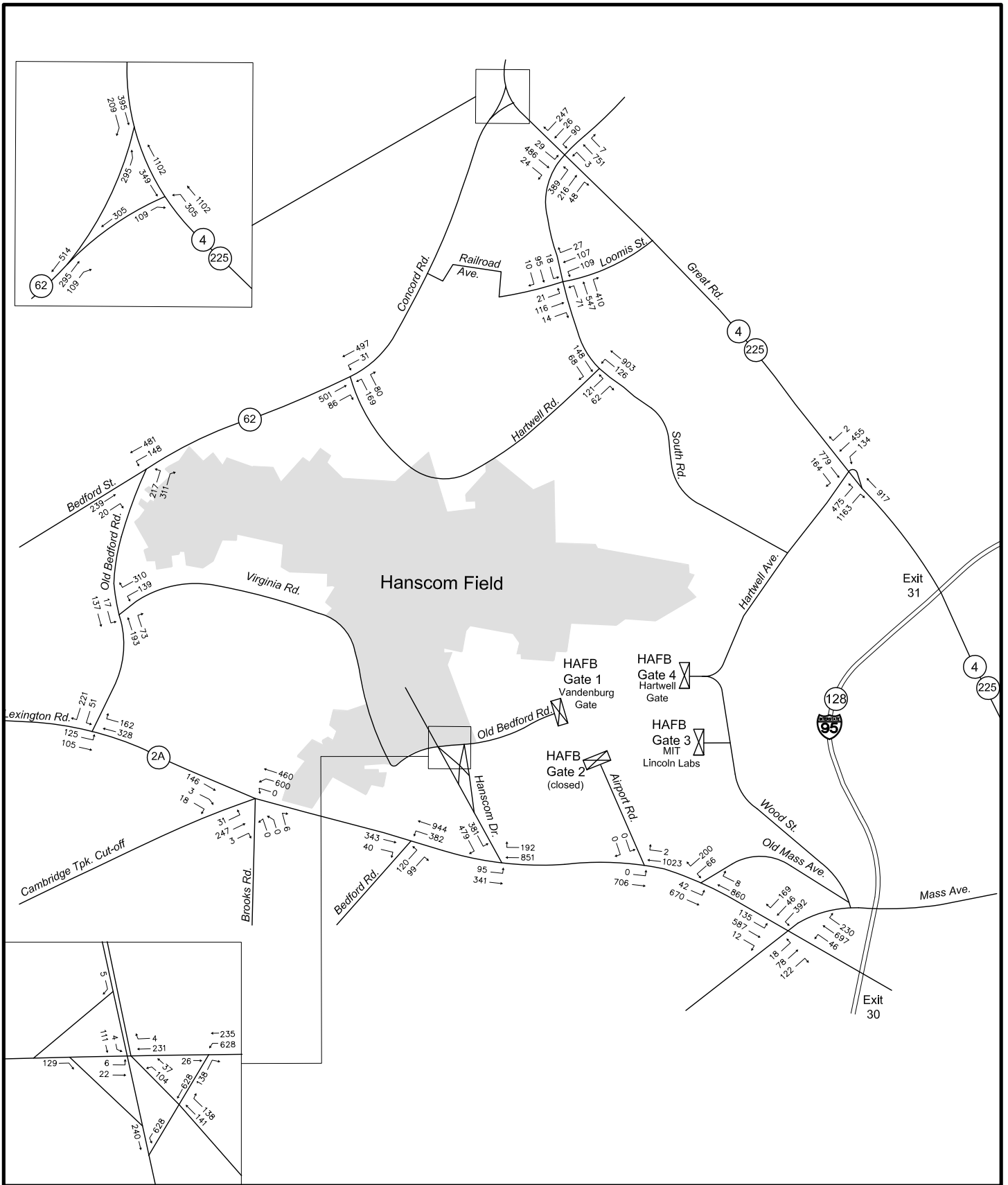
Hanscom Field 2012 ESPR

Bedford, Concord, Lexington, Lincoln, Massachusetts

2020 Morning Peak Hour
Traffic Volumes

Figure 6-18

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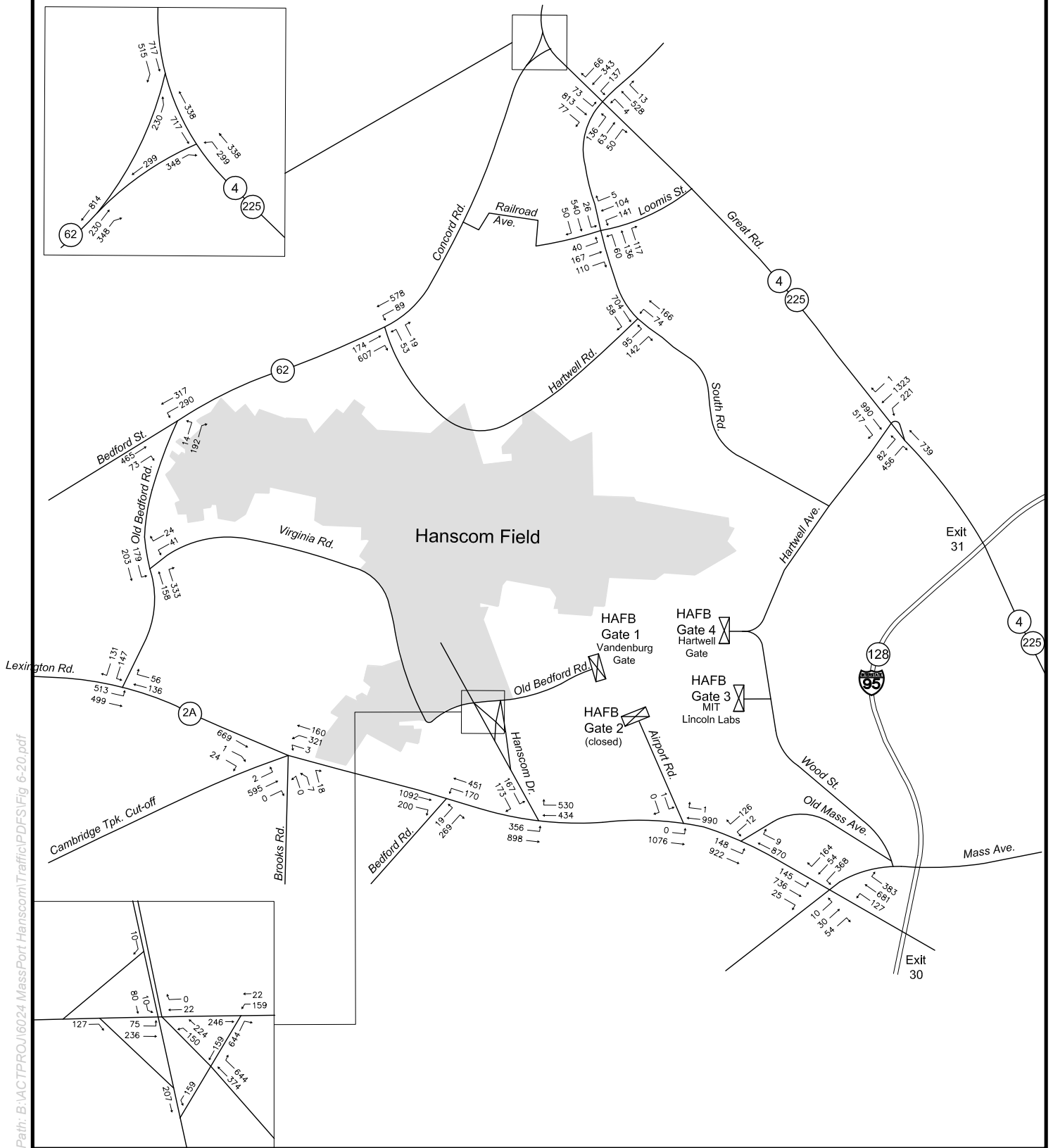


Hanscom Field 2012 ESPR

Bedford, Concord, Lexington, Lincoln, Massachusetts

2020 Afternoon Peak Hour
Traffic Volumes

Figure 6-19



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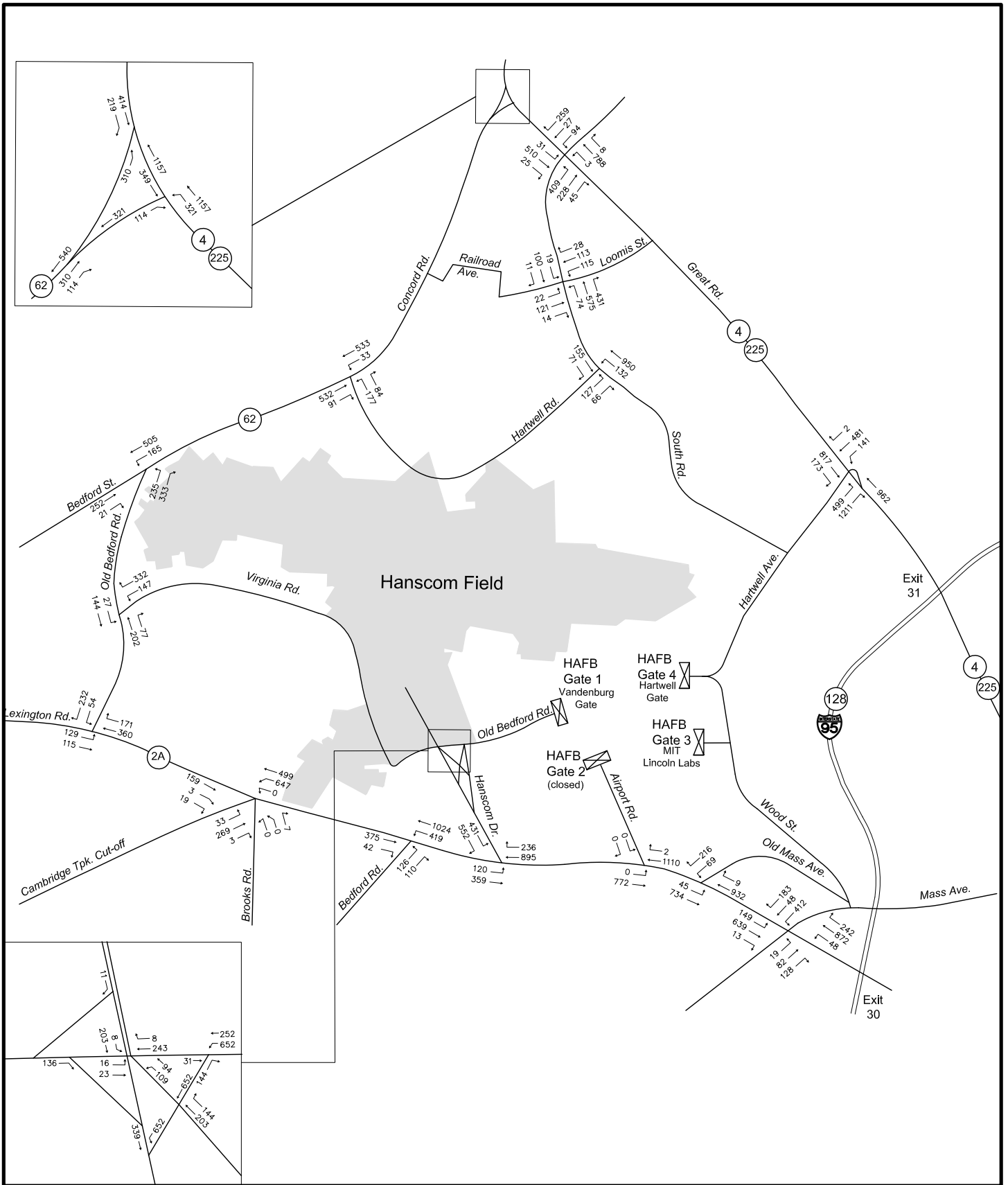
Hanscom Field 2012 ESPR

Bedford, Concord, Lexington, Lincoln, Massachusetts

2030 Morning Peak Hour
Traffic Volumes

Figure 6-20

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Hanscom Field 2012 ESPR

Bedford, Concord, Lexington, Lincoln, Massachusetts

2030 Afternoon Peak Hour
Traffic Volumes

Figure 6-21

6.5.3 Planned roadway improvements

The future roadway networks for the 2020 and 2030 scenarios include planned and proposed roadway improvements as described below. Planning officials from Bedford, Concord, Lexington, and Lincoln were contacted to identify specific roadway improvements that are planned or are under construction within the vicinity of Hanscom Field. Table 6-12 summarizes the roadway improvement projects that were identified (see Figure 6-22 for corresponding locations). None of these projects are anticipated to have a significant impact on traffic operations and circulation in the study area during the morning or afternoon peak hours.

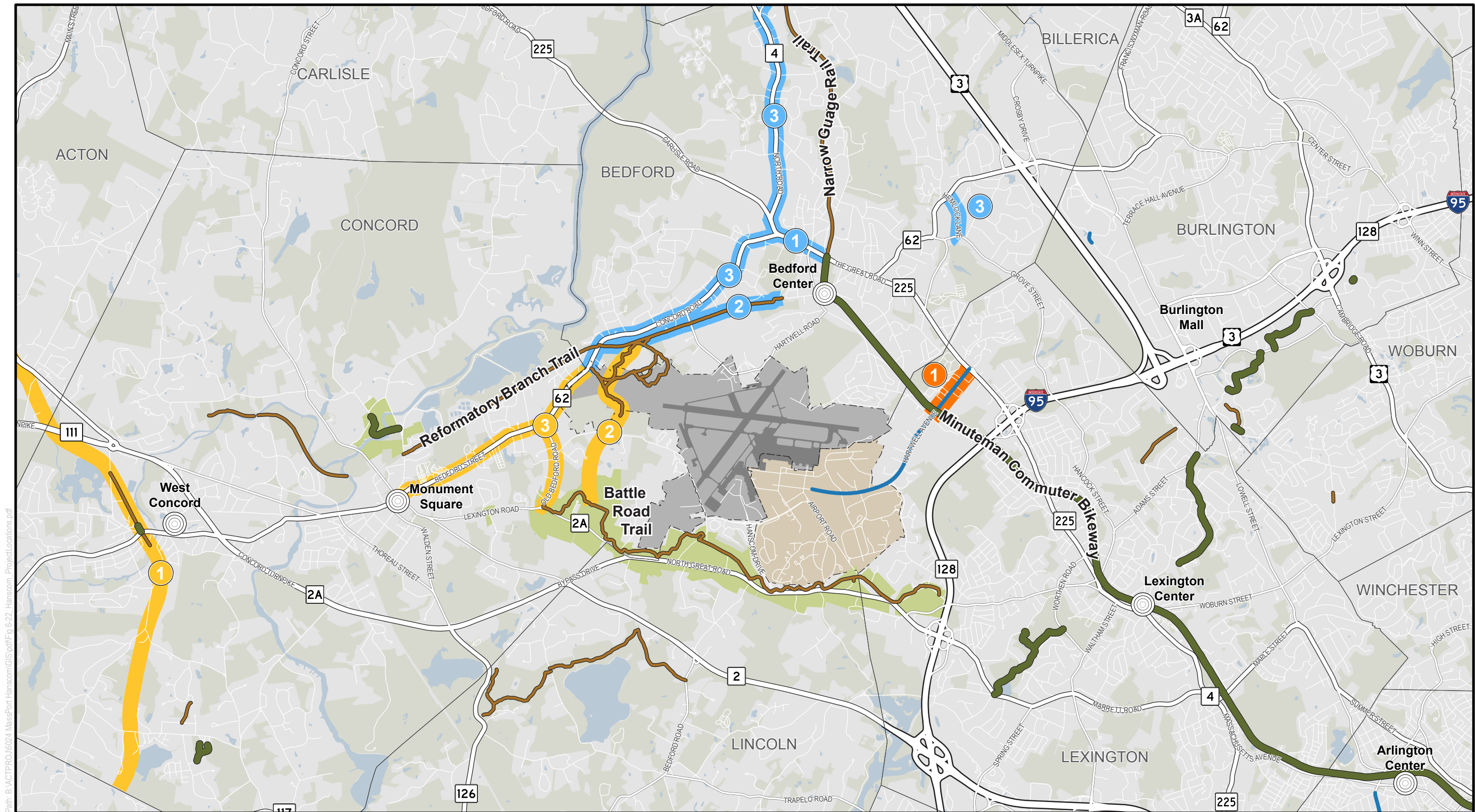
Table 6-12 Planned Transportation Capital Improvement Projects

Map #	Project	Description	Status	2020	2030
Town of Bedford					
1	The Great Road Master Plan	Along The Great Road and North Road between Veterans Memorial Park to the intersection with Carlisle Road. Improvements to pedestrian and bicycle access; streetscape improvements; access management; possible traffic signals at Fletcher Road and Mudge Way	Planning / Conceptual Design	√	√
2	Minuteman Enhancement Project	Pave existing Reformatory Branch railroad corridor from Depot Park to Concord Road	Preliminary Design	√	√
3	Sidewalk construction	Feasibility of constructing sidewalks on Hemlock Lane, Concord Road, North Road	Planning	√	√
Town of Concord					
1	Bruce Freeman Rail Trail	Phase 2 of the trail through West Concord along 25-mile shared-use path between Lowell and Framingham	Planning / Preliminary Design	√	√
2	Concord Land Trust to Gaining Ground Trail Connection	The Natural Resource Commission plans to blaze a trail through land owned by the non-profit organization Gaining Ground to connect the trail system at Massport and then to Reformatory Branch Trail to the Minuteman National Historic Park and Battle Road Trail and eventually connect to Concord and Bedford's larger trail networks	Planning	√	√
3	Sidewalk/ADA Compliance Program	Install new ADA compliant ramps on Old Bedford Road and Bedford Street from the Bedford Town Line to Monument Square	Under Construction	√	√
Town of Lexington					
1	Hartwell Avenue between Bedford Street and Maguire	Reconstruct and widen for four travel lanes, center left-turn lane, bike lanes and sidewalks. Signalize the Hartwell Avenue & Maguire intersection. Update signal at Minuteman Bikeway crossing.	Design	√	√

Source: Personal Communications with staff from the towns of Bedford, Concord, Lexington, and Lincoln

A project currently under construction is the Crosby's Corner project on Route 2 at the Concord/Lincoln town line to allow uninterrupted through movements for eastbound and westbound traffic on Route 2 and improve safety. The project will provide a limited-access roadway with a grade separated connection and service roads. As described in the 2005 *ESPR*, the potential impacts of the Crosby's Corner project were evaluated through the CTPS transportation demand mode, which indicated that the proposed grade separation at Crosby's Corner would have minor impacts on Route 2A demand because Routes 2 and 2A are not generally used as parallel and substitutable routes. The model suggests that after the project is completed, Route 2A may experience minor reductions in peak hour traffic volumes. These adjustments were not included in the 2012 *ESPR* analysis to provide a conservative analysis.

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Path: B:\ACTPROJ\6024 MassPort Hanscom\GIS\pdf\Fig 6-22: Hanscom: Project Locations.pdf



Data Sources: MassGIS Basemap Layers, MAPC Bike/Ped Facilities 2013

- | | | |
|------------------------------------|---|------------------------------------|
| Hanscom Field | Hard Surface Path | Town of Bedford, Ongoing Project |
| Hanscom Air Force Base | Natural Surface Path | Town of Concord, Ongoing Project |
| Municipal Boundary | Bike Lane | Town of Lexington, Ongoing Project |
| Town Center | Proposed Path | |
| Minuteman National Historical Park | Battle Road Scenic Byway | |
| | Proposed Addition to Battle Road Scenic Byway | |

Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Ongoing Projects in Adjacent Jurisdictions

Figure 6-22

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6.5.3.1 Analysis of future traffic volumes

Analysis of the anticipated traffic increases indicates that most of the increases from year 2012 levels occur as a result of regional background traffic growth and traffic from planned and anticipated projects near Hanscom Field. Hanscom Field-related traffic represents approximately 7 to 22 percent of traffic volumes at study area intersections closest to Hanscom Field and less at locations further from the study area in the forecast scenarios.

6.5.3.2 Hanscom Drive traffic volumes

Figure 6-23 illustrates the percent of Hanscom Field-related peak hour traffic volumes on Hanscom Drive for the Existing (2012) and the 2020 and 2030 forecast scenarios. In the existing and 2020 forecast scenarios, Hanscom Field-related traffic makes up between 12 and 14% of traffic and it increases to 22% of traffic in the 2030 forecast scenario. The increase in percentage of Hanscom Field-related traffic in the 2030 forecast scenario is attributable to the trips associated with the full-build out of the museum and hotel.

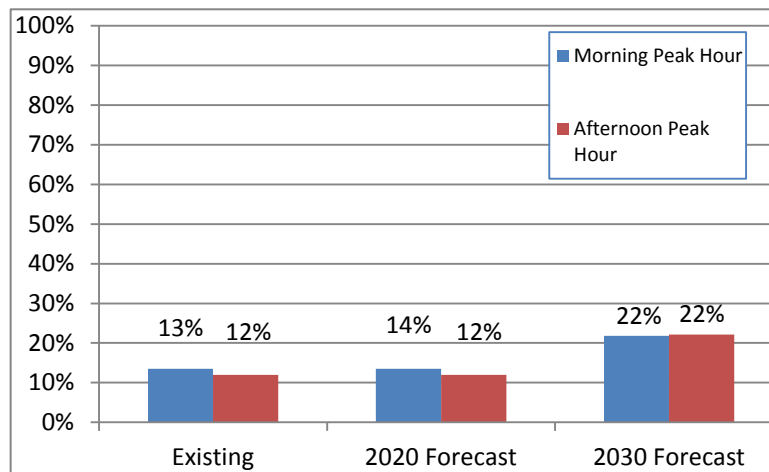


Figure 6-23 Hanscom Field 2020 and 2030 Peak Hour Traffic Volumes as a Percent of Hanscom Drive Traffic Volumes

6.5.3.3 Route 2A traffic volumes

Figure 6-24 illustrates the percent of Hanscom Field-related peak hour traffic volumes on Route 2A for Existing (2012) and the 2020 and 2030 forecast scenarios. In the existing and 2020 forecast scenarios, Hanscom Field-related traffic makes up between 3% and 5% of traffic and increases to 7% of traffic in the 2030 forecast scenario. The increase in percentage of Hanscom Field-related traffic in the 2030 forecast scenario is attributable to the trips associated with the full-build out of the museum and hotel.

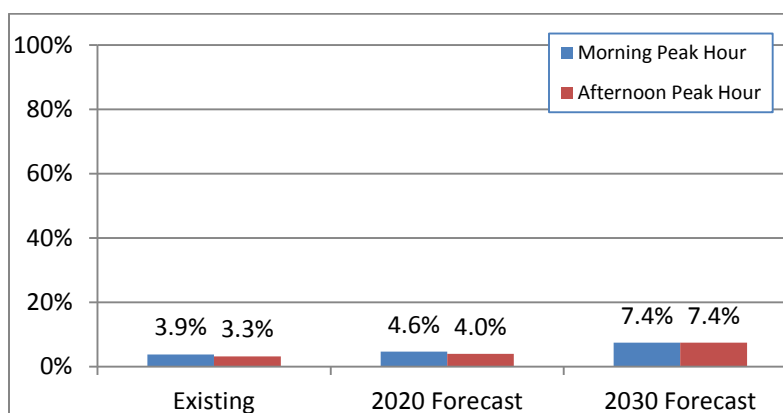


Figure 6-24 Hanscom Field 2020 and 2030 Peak Hour Traffic Volumes as a Percent of Route 2A (East of Hanscom Drive) Traffic Volumes

6.5.4 Future intersection analysis

Future intersection operations were evaluated for study intersections with movements that exceed the ten percent threshold under the 2020 and 2030 forecasts. Table 6-13 shows the intersections that could have one or more traffic movements with ten or more percent Hanscom Field-related traffic volumes under future scenarios. The procedures described earlier in this chapter were used to determine future weekday peak hour intersection operations. To identify effects related to Hanscom Field and those that would be regional in nature, an analysis was also conducted for 2020 and 2030 scenarios assuming no growth in Hanscom Field traffic volumes. These “background growth only” scenarios were compared with the forecast scenarios for each future analysis year. Detailed traffic capacity analysis reports are included in Appendix C.

Table 6-13 Intersections exceeding ten-percent threshold

Refer to Figure 6-5 for locations map.

Intersection	Peak Hour	Analysis Years & Scenarios		
		2012 Existing	2020 Forecast	2030 Forecast
#2 Massachusetts Avenue & Route 2A (Lexington)	Morning			√
	Afternoon			√
#3 Old Massachusetts Avenue & Route 2A (Lexington)	Morning			√
	Afternoon			√
#4 Airport Road & Route 2A (Lexington)	Morning			√
	Afternoon			√
#5 Hanscom Drive/Old Bedford Road (Lincoln)	Morning	√	√	√
	Afternoon	√	√	√
#6 Hanscom Drive/Route 2A (Lincoln)	Morning	√	√	√
	Afternoon	√	√	√
#9 Old Bedford Road/Lexington Road (Concord)	Morning			√
	Afternoon			√
#10 Old Bedford Road/Virginia Road (Concord)	Morning		√	√
	Afternoon	√	√	√

6.5.4.1 2020 forecast scenarios

Tables 6-14 and 6-15 present the comparison of traffic operations for the 2020 forecast scenarios with and without potential increases in Hanscom Field traffic increases for the morning and afternoon peak hours, respectively. These results indicate that most intersections would operate at the same LOS or with only slight increases in delay regardless of the amount of Hanscom Field-related traffic growth. At the

intersection of Route 2A and Hanscom Drive, the analysis indicates that the southbound movements are operating with delay during the morning and afternoon peak hours. However, as described in Section 6.3.5.2 Existing Intersection Operations, the analysis is not accurately representing actual operating conditions based on observations of several unique behaviors at this intersection. However, the additional Hanscom Field-related traffic only contributes 3 to 4% of traffic to these movements. As such, these operational deficiencies are likely a result of regional background traffic growth and traffic from planned and anticipated projects near Hanscom Field, not Hanscom-field related traffic.

Table 6-14 Level of Service for 2020 Forecast: Morning Peak Hour

Refer to Figure 6-5 for locations map.

Intersection	No-Build Scenario			Build Scenario		
	LOS	Delay	v/c	LOS	Delay	v/c
#5 Hanscom Drive/Old Bedford Road						
Hanscom Dr NB LT	A	4.3	0.11	A	3.9	0.11
Hanscom Dr SB LT	A	0.6	0.00	A	0.8	0.00
Old Bedford Rd EB LT	C	20.2	0.39	C	24.9	0.49
Old Bedford Rd EB T	C	22.2	0.48	D	25.5	0.53
Old Bedford Rd WB LT	B	14.6	0.06	C	15.6	0.07
Old Bedford Rd EB T	B	14.3	0.03	C	15.3	0.03
#6 Hanscom Drive/Route 2A						
Rt. 2A EB L	A	9.8	0.31	A	9.9	0.32
Hanscom Dr. SB L	F	>200	>1.20	F	>200	>1.20
Hanscom Dr. SB R	C	21.1	0.46	C	22.0	0.49
#10 Old Bedford Road/Virginia Road						
Virginia Road WB LR	C	21.0	0.26	C	21.5	0.27
Old Bedford Road SB LT	A	5.0	0.17	A	5.1	0.18

Table 6-15 Level of Service for 2020 Forecast: Afternoon Peak Hour

Refer to Figure 6-5 for locations map.

Intersection	No-Build Scenario			Build Scenario		
	LOS	Delay	v/c	LOS	Delay	v/c
#5 Hanscom Drive/Old Bedford Road						
Hanscom Dr NB LT	A	5.9	0.07	A	5.6	0.08
Hanscom Dr SB LT	A	0.3	0.00	A	0.3	0.00
Old Bedford Rd EB LT	C	16.5	0.05	C	18.6	0.06
Old Bedford Rd EB T	B	12.1	0.03	B	12.6	0.03
Old Bedford Rd WB LT	C	16.1	0.39	C	17.4	0.41
Old Bedford Rd EB T	B	13.3	0.20	B	14.0	0.21
#6 Hanscom Drive/Route 2A						
Rt. 2A EB L	B	10.5	0.14	B	10.5	0.14
Hanscom Dr. SB L	F	>200	>1.20	F	>200	>1.20
Hanscom Dr. SB R	F	>200	>1.20	F	>200	>1.20
#10 Old Bedford Road/Virginia Road						
Virginia Road WB LR	D	32.8	0.83	D	33.2	0.83
Old Bedford Road SB LT	A	1.2	0.02	A	1.2	0.02

6.5.4.2 2030 forecast scenarios

Tables 6.16 and 6.17 present the comparison of traffic operations for the 2030 forecast scenarios with and without potential increases in Hanscom Field traffic for the morning and afternoon peak hours, respectively. These results indicate that most intersections would operate at the same LOS or with only slight increases in delay with Hanscom Field-related traffic growth compared to with background only. There are several intersections that would operate with one or more movements at LOS F during one or

more peak hours. All movements that operate at LOS F in the build scenario also operate at LOS F in the no build scenario. Furthermore, Hanscom Field-related traffic has no or a minimal contribution to these movements, as described below. As such, these operational deficiencies are likely a result of regional background traffic growth and traffic from planned and anticipated projects near Hanscom Field, not Hanscom-field related traffic.

- Mass Avenue/Route 2A - Several movements (Route 2A eastbound left, Route 2A westbound through and Mass Avenue southbound left) operate at LOS F both with background traffic only and with Hanscom Field traffic. The additional Hanscom Field-related traffic only contributes from 0 to 7% on each of these movements.
- Old Mass Avenue/Route 2A - The southbound approach operates at LOS F for the morning and afternoon peak hour with background traffic only and with Hanscom Field traffic. The additional Hanscom Field-related traffic only contributes 3 to 8% of traffic to this movement.
- Airport Road/Route 2A - The southbound approach operates at LOS F for the morning peak hour in both the 2030 With Background Only and 2030 Forecast scenarios. However, the gate to Hanscom AFB on Airport Road was closed in 2011 and this road does not provide access to other properties. Therefore, there is only one vehicle turning left from Airport Road during the morning peak hour and no cars during the afternoon peak hour. The additional Hanscom Field-related traffic does not contribute any traffic to this movement.
- Hanscom Drive/Route 2A - The analysis indicates that the southbound movements are operating with significant delay during the morning and afternoon peak hours. However, as described in section 6.3.5.2 Existing Intersection Operations, the analysis is not accurately representing actual operating conditions based on observations of several unique behaviors at this intersection. The additional Hanscom Field-related traffic only contributes 12 to 16% of traffic to these movements.

At Hanscom Drive/Old Bedford Road, the eastbound approach operates at LOS B or C with Background Only and LOS E or F with Hanscom Field Traffic. While Hanscom Field would not contribute a large percentage of traffic to these eastbound movements, Hanscom Field traffic would contribute to the northbound and southbound movements, which conflict with the eastbound movements. As such, the changes in LOS may be attributed to forecasted Hanscom Field traffic volume increases. The plans for redesign of the Vandenburg Gate include in the construction of a roundabout at this intersection, which would result in improved LOS.

Table 6-16 Level of Service for 2030 Forecast: Morning Peak Hour

Refer to Figure 6-5 for locations map.

Intersection	2030 With Background Only			2030 with Hanscom Field Traffic		
	LOS	Delay	v/c	LOS	Delay	v/c
#2 Mass Avenue/Route 2A						
Rt. 2A EB L	F	173.4	1.20	F	190.2	>1.20
Rt. 2A EB TR	B	16.3	0.73	B	16.9	0.74
Rt. 2A WB L	C	23.8	0.65	C	27.3	0.69
Rt. 2A WB TR	F	121.9	1.19	F	141.6	>1.20
Mass Ave NB LTR	B	29.6	0.13	C	29.6	0.13
Mass Ave SB L	F	143.5	1.17	F	143.5	1.17
Mass Ave SB TR	B	31.4	0.30	C	31.5	0.32
#3 Old Mass Avenue/Route 2A						
Rt. 2A EB LT	A	7.3	0.23	A	8.1	0.24
Old Mass Ave SB LR	F	86.1	0.86	F	114.6	0.96
#4 Airport Road/Route 2A						
Airport Rd SB LR	F	85.7	0.02	F	98.5	0.03

Intersection	2030 With Background Only			2030 with Hanscom Field Traffic		
	LOS	Delay	v/c	LOS	Delay	v/c
#5 Hanscom Drive/Old Bedford Road						
Hanscom Dr NB LT	A	4.7	0.11	A	3.7	0.12
Hanscom Dr SB LT	A	0.7	0.00	A	0.8	0.01
Old Bedford Rd EB LT	C	20.7	0.41	F	61.0	0.83
Old Bedford Rd EB T	C	22.5	0.49	E	39.3	0.67
Old Bedford Rd WB LT	B	14.6	0.06	C	18.4	0.08
Old Bedford Rd EB T	B	13.6	0.03	C	16.7	0.04
#6 Hanscom Drive/Route 2A						
Rt. 2A EB L	B	10.0	0.33	B	10.5	0.38
Hanscom Dr. SB L	F	>200	>1.20	F	>200	>1.20
Hanscom Dr. SB R	C	23.2	0.51	D	29.7	0.63
#10 Old Bedford Road/Virginia Road						
Virginia Road WB LR	C	23.1	0.30	D	26.3	0.36
Old Bedford Road SB LT	A	5.2	0.19	A	5.6	0.21

Table 6-17 Level of Service for 2030 Forecast: Afternoon Peak Hour

Refer to Figure 6-5 for locations map.

Intersection	2030 With Background Only			2030 with Hanscom Field Traffic		
	LOS	Delay	v/c	LOS	Delay	v/c
#2 Mass Avenue/Route 2A						
Rt. 2A EB L	F	>200	>1.20	F	>200	>1.20
Rt. 2A EB TR	C	25.0	0.67	C	26.5	0.71
Rt. 2A WB L	C	22.8	0.24	C	23.5	0.27
Rt. 2A WB TR	F	162.2	>1.20	F	177.0	>1.20
Mass Ave NB LTR	C	34.6	0.37	C	34.6	0.37
Mass Ave SB L	F	>200	>1.20	F	>200	>1.20
Mass Ave SB TR	C	33.1	0.27	C	33.2	0.28
#3 Old Mass Avenue/Route 2A						
Rt. 2A EB LT	A	2.1	0.08	A	2.2	0.08
Old Mass Ave SB LR	F	>200	>1.20	F	>200	>1.20
#4 Airport Road/Route 2A						
Airport Rd SB LR	-	-	-	-	-	-
#5 Hanscom Drive/Old Bedford Road						
Hanscom Dr NB LT	A	6.2	0.09	A	4.4	0.09
Hanscom Dr SB LT	A	0.1	0.00	A	0.3	0.01
Old Bedford Rd EB LT	C	24.6	0.08	F	59.3	0.34
Old Bedford Rd EB T	B	13.9	0.04	C	15.1	0.05
Old Bedford Rd WB LT	C	22.0	0.51	D	26.8	0.57
Old Bedford Rd EB T	C	16.1	0.26	C	17.7	0.30
#6 Hanscom Drive/Route 2A						
Rt. 2A EB L	B	10.6	0.15	B	10.8	0.18
Hanscom Dr. SB L	F	>200	>1.20	F	>200	>1.20
Hanscom Dr. SB R	F	>200	>1.20	F	>200	>1.20
#10 Old Bedford Road/Virginia Road						
Virginia Road WB LR	D	27.1	0.75	D	29.0	0.77
Old Bedford Road SB LT	A	1.1	0.02	A	1.8	0.03

6.6 Potential Environmentally Beneficial Measures

6.6.1 Traffic management approaches

The intersection of Route 2A and Hanscom Drive may benefit from the use of additional traffic management approaches, especially if volumes reach the forecasted levels for the 2020 and 2030 scenarios. However, as described previously, Hanscom Field-related traffic is only a small contributor to

the total traffic at the intersection with the remainder resulting from regional traffic and traffic from planned and anticipated projects in the study area. The use of a traffic control officer at Hanscom Drive and Route 2A during the morning peak hour and afternoon would improve the operation of the intersection. Additionally, a traffic signal would improve operations at the intersection and the current traffic volumes meet peak-hour thresholds warranting a traffic signal according to Figure 4C-4 of the 2009 Manual of Uniform Traffic Control Devices.

The intersection of Hanscom Drive and Old Bedford Road may benefit from additional traffic management approaches if the volumes reach the forecasted levels for the 2030 scenarios. The use of a traffic control officer or the installation of an all-way stop control may be considered at this intersection. Additionally, the plans for redesign of the Vandenburg Gate include a roundabout at the intersection, which would result in improved level of service.

6.6.2 Transportation Demand Management

The goal of Transportation Demand Management (TDM) is to reduce the number of single occupancy vehicles to increase the capacity of the transportation network and to reduce traffic congestion, traffic delay, and vehicle miles travelled during peak travel times. As part of the development of this report, the potential for expansion of TDM programs was explored at a regularly scheduled tenant meeting held at the Civil Air Terminal. Staff continues to discuss TDM strategies at these meetings to ensure that as programs are implemented they continue to meet the needs of students and employees at Hanscom and are effective in reducing single occupant vehicle use. Furthermore, Massport is planning TDM strategies for Hanscom Field including promoting transit service, initiating collaborations with Hanscom AFB, developing partnerships with MassRIDES, encouraging car pools, supporting vehicle sharing, increasing the viability of active transportation and additional strategies, which are described below. Additional information on how these recommendations will be implemented is provided in the sections below.

6.6.2.1 Travel survey findings

In a travel survey administered in July 2013 to employees and students at Hanscom Field, Massport sought to identify opportunities for environmentally beneficial measures that could reduce single-occupancy vehicle trips to and from the study area. Of the 65 respondents, 86% drive alone for their commute, while 12% use transit to reach the campus and 2% bicycle. 90% of respondents were employees, while 10% were students. Of the transit riders who responded, nearly all use the MBTA's 76 bus for at least the final leg of their trip.

Even though a large share of employees and students at Hanscom Field drive alone, there are opportunities to reduce the number of single-occupancy vehicles commuting each day. 28% of survey respondents expressed interest in learning about programs and incentives encouraging alternate modes of transportation. Respondents expressed greatest interest in replacing vehicle trips with transit, followed by carpooling/vanpooling, bicycling, and walking.

The most significant barrier to commuters using transit is the perception of convenience. 63% of respondents stated that lack of direct transit service between their homes and Hanscom Field was a deciding factor. 43% report not having a bus stop within convenient distance of their homes. 39% were dissuaded by irregular or infrequent service. On the flipside, those who drive alone overwhelmingly cite their commute time and convenience as their primary reasons for driving. Weighted for preference, these two factors were valued almost twice as much as irregular work schedules and needing a car for personal errands, the next two highest responses. Those who drive alone also enjoy free and convenient parking at

Hanscom Field (87% park in unrestricted lots). While respondents reported that they drive alone for the convenience and time savings, there is still an opportunity to replace trips and encourage alternate modes of transportation. The average one-way commute time reported was approximately 49 minutes. Given this duration, the additional time required to detour to pick up additional passenger is relatively small and the combination of the high cost of fuel and the relatively high average length of commutes suggest a potential to promote ridesharing as a way to reduce single occupancy vehicle trips. The majority (57%) of commuters rarely or never leave Hanscom Field during the day. These responses further suggest that if commuters who drive alone found a transit route or rideshare that was competitive in duration and at a suitable time, they could be motivated to replace at least some of their vehicle trips.

35% of respondents expressed they may be interested in carpooling if the schedule was accommodating. When visitors currently take alternative modes, most often they report either being dropped off or carpooling. Respondents reported that most motivating would be either financial incentives or finding suitable carpool partners to meet their scheduling demands. Also, having a program like Guaranteed Ride Home was listed as a valued motivator, as employees and students may be worried about not having the same flexibility to come and go that comes with a vehicle. The responses suggest that benefits associated with TMA membership might be prime motivators to reducing single occupancy vehicle trips.

Finally, 30% of respondents expressed interest in bicycling to commute—among those interested, they reported that incentives like shower and locker facilities, and low-stress bike paths would be the most likely to encourage them to bike. 23% expressed interest in combining biking and walking with transit; 75% of respondents feel they live too far to bicycle to work, but providing amenities like route planning services and transit stop bike parking might create multi-modal trips to replace vehicle trips.

6.6.2.2 Promoting transit service at Hanscom Field

Primary transit service to Hanscom Field is provided by the MBTA route 76 bus, which makes stops at the Civil Air Terminal and the intersection of Hanscom Field Drive and Old Bedford Road. However, several transit opportunities also occur in the area. The LEXPRESS Bus, which serves routes in the Town of Lexington between Lexington Center and Depot Square, operates a route that comes within a mile of the study area.

To promote use of transit, schedules for the MBTA buses that serve Civil Air Terminal are posted at the main entrance to the terminal building. In addition, information about using the MBTA bus to access the terminal is available on Massport's "Get U There" on-line application. Massport will continue to seek additional strategies and disseminate information about nearby transit access, such as transit hubs in Lexington Center (MBTA bus, LEXPRESS bus), Concord Center (MBTA bus and commuter rail), and Depot Square (LEXPRESS bus), so that commuters can plan to park-and-ride, bike, or walk parts of their commutes.

Strategies to increase transit ridership will continue current efforts to post information for employees, including on-line, at transit stops, and at regular Transportation Fairs (see Section 6.6.2.3 TDM Partnerships with Hanscom Air Force Base). Additionally, employees and students who completed the travel survey named one of the primary barriers to using transit was the lack of suitable service at times when they needed service. Massport will explore with municipal and regional partners the feasibility of expanding bus frequency throughout the day to make transit viable for more visitors to the study area. Massport will also participate in discussions with neighboring towns, Chambers of Commerce, the 128 Business Council, and the MBTA to review current bus service and amenities, and opportunities to

expand service to Hanscom Field. Massport will initiate this discussion through its participation in the Hanscom Field Advisory Committee (HFAC) at a regularly scheduled meeting.

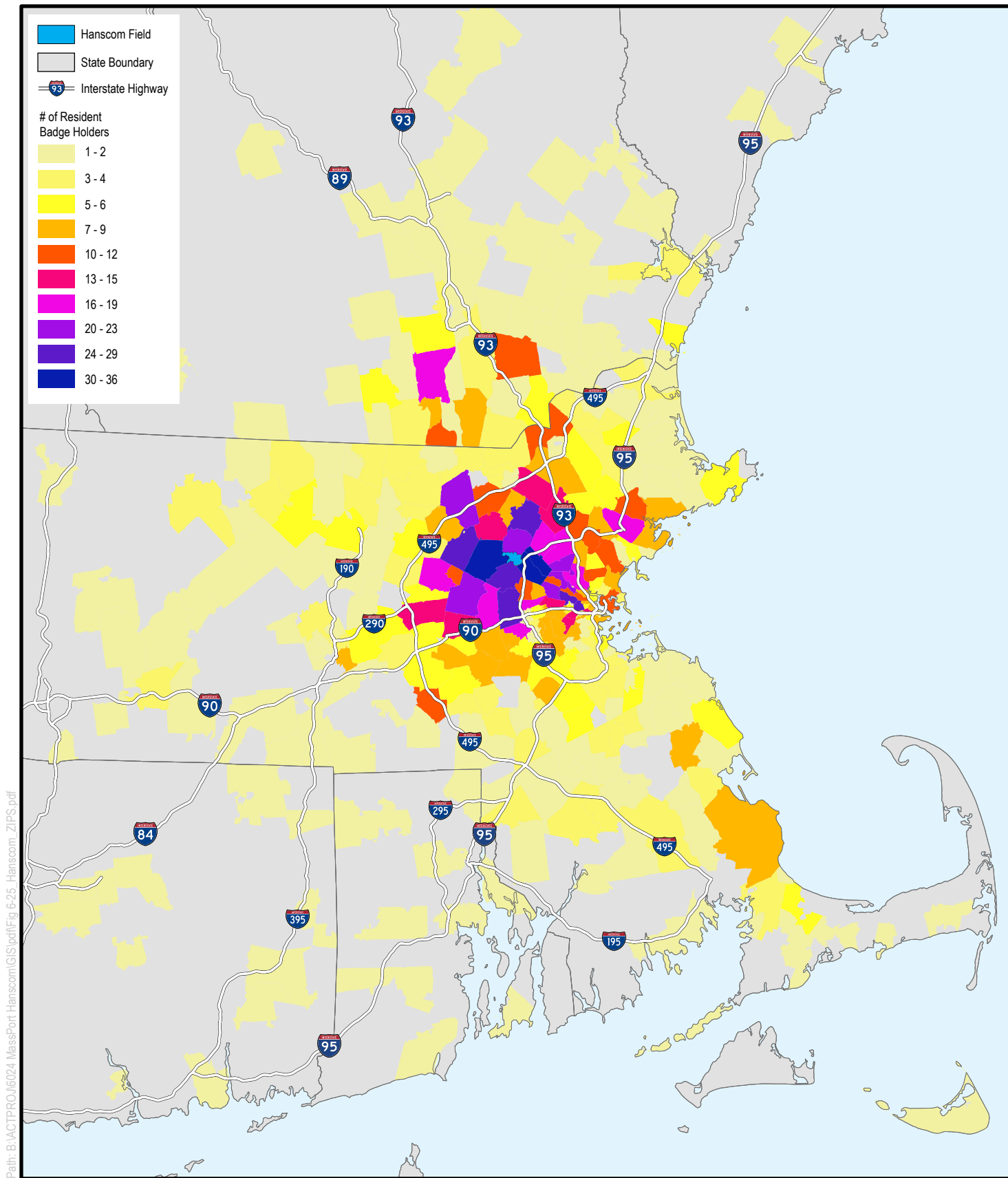
6.6.2.3 TDM partnerships with Hanscom AFB

Hanscom AFB has over 8,000 employees at the Base itself, and 2,000 to 3,000 additional employees at MIT Lincoln Labs (located on Hanscom AFB and operated by MIT). The Base has research and development space, residences, retail and commercial space, a medical facility, and childcare facilities. As part of its environmental permitting, the Base is required to develop and submit an annual rideshare report and identify potential strategies to reduce drive alone commute trips. The Base currently deploys a wide range of TDM measures and recently has seen an increased interest and participation in carpooling and vanpools. For vanpooling, the Base has partnered with the private company vRides. vRides operates by certifying individuals to drive company-owned vans home and pick up other members along predetermined routes. The Base maintains a ride-matching database of interested employees, who can be matched with other employees based on their location and commute time.

Massport has begun to collaborate with ground transportation coordinators at the AFB to provide information about TDM programs to employees and students working at Hanscom Field. Beginning in the winter of 2014, Massport and the AFB, in partnership with MassRIDES, will co-host a Transportation Fair on Hanscom Field to promote carpools, vanpools and available reward programs. Hanscom AFB, in partnership with MassRIDES and vRides, began hosting regular Transportation Fairs for its employees and visitors in 2013. The fairs serve to promote transportation alternatives and provide people with information about transit options, trip planning, and incentives to reduce single occupancy vehicle trips. As part of the event, MassRIDES provides information about existing and potential carpools and vanpools with maps showing the originating zip codes of people commuting to the Base. At fairs held during warmer months, there is increased focus on walking and bicycling including route planning assistance. Massport and AFB staff should continue to communicate regularly to identify additional partnership opportunities such as bicycle sharing (see below).

6.6.2.4 Partnership with MassRIDES

Massport is also pursuing opportunities to work with MassRIDES to reduce the number of single occupancy vehicles traveling to and from Hanscom Field. Massport has become an official program partner with MassRIDES which will allow employees on Hanscom Field to access commute options programs such as ride matching for carpools and vanpools, NuRide rewards for green commuters and an emergency ride home service. To promote the partnership, Massport will work with MassRIDES to deliver an email communication to all employees outlining the services offered. In addition, Massport has invited MassRIDES to attend and present at a monthly tenant meeting to educate tenants on available programs and services. Massport is also planning to partner with MassRIDES to host a table during the transportation fair at the Hanscom Civilian Terminal during an upcoming Transportation Fair in conjunction with Hanscom AFB. Figure 6-25 illustrates the home zip codes of badge holders at Hanscom Field, which shows the potential for carpooling and vanpooling.



Hanscom Field 2012 ESPR

Bedford, Concord, Lexington, Lincoln, Massachusetts

Hanscom Field Badge Holders: Resident Count by Zip Code

6.6.2.5 Participation in TMA

Massport will also continue to consider opportunities to work with the 128BC, which is the Transportation Management Association (TMA) that serves Burlington, Lexington, Needham, Newton, Waltham, Wellesley, Weston, and Woburn. 128BC offers member services such as shuttle service access; guaranteed Ride Home; commuter survey, analysis, and incentive programs; individual route planning assistance; carpool/vanpool matching; bike-to-work/walk-to-work planning and supportive services (including bike repair discounts at MyBike); and many other services to help reduce single occupancy vehicle trips.

The provision of shuttle service is provided to member businesses based on an assessment by the 128BC for the potential viability of new service at an additional cost to the employer and individual shuttle user. Due to logistical challenges, it is not likely feasible to extend one of the existing shuttles to serve Hanscom Field.

6.6.2.6 Strategies to increase carpooling

The most viable alternative mode, given the spatial diffusion of commuters to the base and required up-front cost to add transit service, is carpooling and vanpooling expansion. While partnering with Hanscom AFB, MassRIDES or 128BC would assist employees at Hanscom Field in locating carpool options, Massport is also exploring opportunities to promote carpooling including:

- Collaborating with the MBTA, neighboring towns, 128BC, MIT, and Hanscom AFB to improve transit access and park-and-ride connections
- Offering parking incentives to carpool participants
- Promoting NuRide tools to provide ride-matching services
- Encouraging employees to log non-single occupancy vehicle trips through NuRide
- Creating parking space for car-share vehicles.

Massport is investigating opportunities to incentivize vanpools and carpools. In addition to encouraging rewards, the agency is considering designating priority parking spaces in front of the Civil Terminal and other locations for vehicles used for vanpools and carpools. While there are currently no parking fees at Hanscom Field, in 2005 Massport installed infrastructure necessary to collect parking fees. If parking at Hanscom Field does transition to a fee-based structure, vanpools and carpools could still be allowed to park free of charge.

Massport can also connect commuters with the NuRide online tool. NuRide can assist commuters with ride-matching, and also provides a portal for logging non-single occupancy vehicle trips and mileage. As commuters begin logging miles of alternative modes of transportation, Massport can both encourage mode-shift (commuters will receive incentives for meeting benchmarks, and take pride in reducing their carbon footprint), and track the reduction of single occupancy vehicle trips and associated impacts on pollution across Hanscom Field.

6.6.2.7 Vehicle sharing

Massport sees opportunities to work with car-sharing providers to provide parking spaces for short-term car rentals. While the majority of employees do not leave Hanscom Field during the day, many cited the desire of having a vehicle available for when they need to run personal and work-related errands as reason for driving alone to work. Having car-share vehicles available provides an alternative that removes the barrier of not having a car when needed, and will help encourage mode-shift.

6.6.2.8 Active transportation

In addition to promoting transit and other vehicle-based alternatives to single occupancy vehicles, Massport is working to increase the viability of bicycling and walking.

Bicycle Network Expansion

The Minuteman Commuter Bikeway connects Alewife Station in Cambridge with Bedford Depot, and is easily accessible in Arlington Center, Lexington Center, and along the Massachusetts Ave corridor. It terminates at the Bedford Depot, where it connects to two unpaved rail trails: the Reformatory Branch Trail, which continues around the northern boundary of Hanscom Field to Concord Center; and the Bedford Narrow Gauge Trail, which continues to Billerica. The communities along the trail have also been expanding bicycle facilities which have helped increase access to and from the trail. Paving the Reformatory Branch Trail, currently in development, would increase the comfort-level for all types of cyclists to travel on the trail. In 2011, to help expand the regional trail system, Massport partnered with the towns of Bedford and Concord to help create an expanded network of hiking trails that connects trails in Bedford to Gaining Ground in Concord.

Other improvements to roadways around Hanscom Field would further support bicycling as a viable form of transportation and recreation. Route 2A (North Great Road) currently provides unique east-west access south of Hanscom Field. Between Massachusetts Avenue in Lexington and Lexington Road in Concord, North Great Road (Route 2A) has a pavement width of 24', divided into two 11' travel lanes and 1' marked shoulder. The ROW is typically 40' in this section and the speed limit is 40 mph. Where feasible, additional shoulder width should be considered to improve conditions for bicycling. Providing 3 additional feet on either side of the roadway would permit the creation of 4' wide bike lanes. If sufficient width is not available to mark as an exclusive bike lane, a wider lane can be established to improve conditions for bicycling. Providing wider shoulders would also help reduce the lifecycle costs associated with roadway maintenance as the edge of the roadway would be subject to less load and risk of deterioration. Additional shoulder width should be provided where feasible if physical constraints make it practical to achieve throughout the entire corridors. These changes will also improve connections between the Minute Man National Historical Park and the Minuteman Bike Trail.

Hanscom Drive will be reconstructed as part a project to improve the Hanscom Visitor Control Center at the Vandenberg Gate to Hanscom AFB. While Hanscom Drive currently has no dedicated bicycle or pedestrian facilities, the proposed plans for the redesign of the Vandenberg Gate include the provision of wide shoulders for bicycle access as well as pedestrian accommodations. To support walking and bicycling between Hanscom Field, Old Bedford Road and Route 2A, dedicated facilities should be provided as part of this project. As anticipated pedestrian volumes are relatively low, a combined shared use facility separate from the roadway may be appropriate. Crossing treatments should also be provided to allow bicyclists and pedestrians to cross ramps, access roads and the roundabout.

Finally, while some bicycle parking is currently available, these facilities should be improved and expanded to better serve employees and visitors to Hanscom Field. There are currently two bicycle racks visibly located in the parking lot immediately adjacent to the Civil Air Terminal; Massport will look at replacing the existing racks with units that comply with the guidelines in the AASHTO Guide for the Development of Bicycle Facilities to provide proper two points of support for the bicycle frame and support easy locking. To further encourage bicycling, consideration is also being given to providing cover to the racks.

Massport is also exploring opportunities to provide indoor parking for employees to place their bicycles in a secure location for protection from weather and elements. In addition to any existing opportunities, this will also be considered as a part of any future development projects. In addition to bicycle parking, Massport is considering other facilities and amenities to encourage bicycling. Other potential facilities may include the self-service repair station similar to what is provided at MIT Lincoln Labs. Massport will also work with other tenants at Hanscom to promote the use of facilities to encourage and support bicycling. Another important amenity to encourage bicycling that was identified in the Travel Survey is the availability of lockers and showers. Showers are currently available for Massport employees and Hanscom Field tenants at the Civil Terminal and should be better promoted to staff.

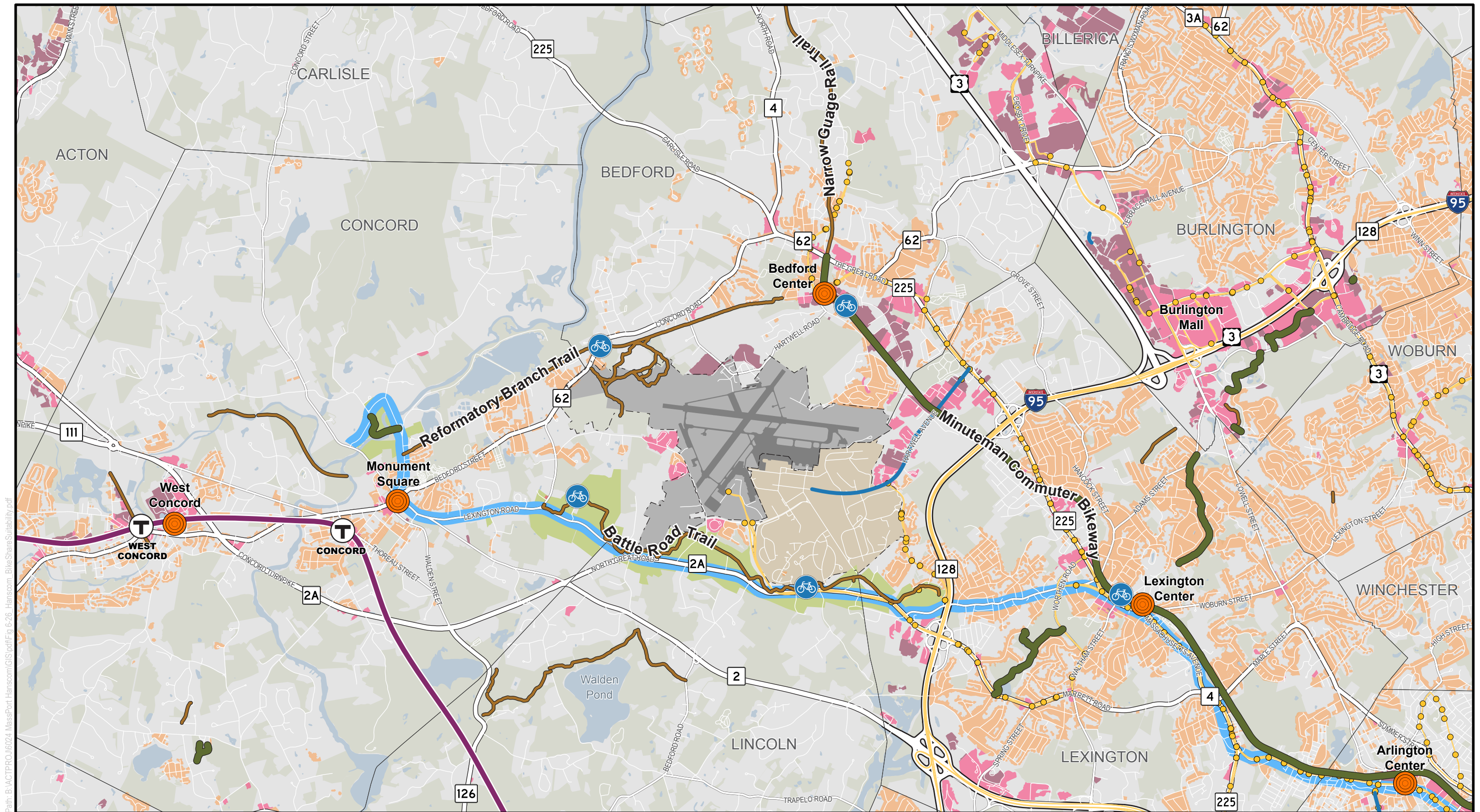
Bicycle Sharing

Massport sees the potential to promote bicycle sharing as a means to encourage bicycling at Hanscom Field as well as in surrounding areas. In meetings with transportation coordinators from the AFB, initial discussions have been held to explore the potential benefits of such a program for Hanscom Field and the Base as well as to surrounding areas. Compared to traditional bicycle rental, the primary benefit of bicycle sharing is the ability for the user to make one-way trips and lower the cost of shorter term uses.

As bicycle share provides an additional mobility option for ‘last mile’ connections to and from transit, existing programs have reported an increase in the overall number of transit users. For example the Concord MBTA commuter rail station is an approximately 25 minute bicycle ride from the Civil Air Terminal. While there are no exclusive facilities along this route, the existing network includes streets with wide curb lanes and relatively low traffic volumes. Bicycle sharing could also be used in conjunction with MBTA commuter rail for visitors to use bicycles to visit historic properties such as the Wayside and sites along the Battle Road and Minuteman National Historical Park. Figure 6-26 illustrates many of the destinations that a bicycle system could potentially be accessed in the area surrounding Hanscom Field. In considering the potential for bicycle share, Massport sees two primary options 1) a ‘campus’ program approach focused on Hanscom Field and the AFB; and 2) a regional program with neighboring towns and other agencies.

There are two basic bicycle share system types: either station-based on fixed location docking stations or stationless systems. The “Hubway” system used in Boston, Cambridge, Somerville and Brookline relies on bicycle availability at docking stations. Users can rent bicycles using two different methods: 1) register on-line for annual or monthly membership and receive a key which unlocks bicycles at any station, or 2) pay at a station for a 1 day or 3 day pass and receive a code which will unlock a bike at any station during that period. Rates are structured to promote a short trip and high levels of circulation. By contrast, stationless systems require users to register on-line to receive a code that will unlock an individual bicycle. Bicycles in stationless systems typically feature GPS so that users and managers can locate individual bikes. Stationless systems also require that ample bicycle parking be made available in the service area.

Bicycle sharing stations locations should be both convenient to potential users and placed in visible locations. Potential locations surrounding Hanscom Field include: Arlington, Bedford, Concord (i.e. West Concord and Monument Square), Lexington and Lincoln town centers; commuter rail train stations in Concord and Lincoln; and Minute Man National Historical Park (i.e. North Bridge Visitor Center and Minute Man Visitor Center). On Hanscom Field, potential locations include the Civil Air Terminal and the National Aviation Academy. For Hanscom Air Force Base, potential locations include the Minuteman Commons, Fitness and Sports Center, Lincoln Labs and other residential, office and commercial locations that generate relatively significant trips on the base.



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- | | | | | | |
|--|------------------------------------|--|--------------------------------------|--|----------------------------|
| | Hanscom Field | | Hard Surface Path | | MBTA Commuter Rail Station |
| | Hanscom Air Force Base | | Natural Surface Path | | MBTA Commuter Rail Line |
| | Municipal Boundary | | Bike Lane | | MBTA Bus Route |
| | Minuteman National Historical Park | | Trailhead or Major Trail Entry Point | | MBTA Bus Stop |
| | Retail Land Use | | Battle Road Scenic Byway | | Town Center |
| | Industrial Land Use | | | | |
| | Medium-Density Residential | | | | |



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Bikeshare Suitability Map

Data Sources: MassGIS Basemap Layers, MAPC Bike/Ped Facilities 2013, Battle Road Scenic Byway Corridor Management Plan

Figure 6-26

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A key consideration that would need to be explored involves structures for a regional agreement regarding the program's operational model. A further feasibility study for the program will also need to consider how such a program could be funded, the potential for a relationship with the existing Hubway network, maintenance, and a more in depth analysis of the potential demand for bicycle sharing in the area given the relative low density. One strategy that has been used in other suburban programs is to provide longer usage periods to reflect the greater distances traveled compared to urban environment.

6.6.2.9 Additional Strategies to promote TDM at Hanscom Field

Administrative staff at Hanscom Field is developing a community and airport user outreach program. As part of this effort, staff is creating a stand-alone web site for Hanscom Field, in addition to developing a social media presence for the airport. One goal of the effort is to improve Massport's online and social media presence. As one of the key strategies of TDM efforts is the creative use of communication tools to promote alternatives, staff will be considering how best to integrate information and resources about alternatives to single occupancy vehicles. Potential improvements include links to existing carpools and vanpools that are accepting new riders and providing information and support on using bicycles to access the Hanscom Field.

6.6.2.10 Conclusion

Massport is committed to seeking opportunities to reduce single occupancy vehicle travel to Hanscom Field. Travel surveys indicate that there is the potential to increase ridesharing as an alternative for some trips. However, the combination of suburban land use patterns, limited transit service and long average distances traveled limit the ability to promote transit and bicycling and walking as alternatives for a significant number of trips.

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7 Noise

This chapter presents the noise conditions at Hanscom Field for 2000, 2005 and 2012 to illustrate recent trends in noise up to present conditions, and for the 2020 and 2030 scenarios to predict future noise for the airport activity levels forecasted. A broad array of metrics is used to describe noise conditions including Day-Night Sound Level (DNL), Time Above a decibel threshold (TA), Total Noise Exposure (EXP) and Distribution of Sound Exposure Levels (SEL). Noise levels for each of the metrics are evaluated at noise sensitive receptors including hospitals schools, religious sites, public facilities, and National Register of Historic Places and/or State Register of Historic Places presented in the chapter by municipality. Massport's noise abatement program is also described, including how Massport is working with local stakeholders to assess noise and mitigate impacts.

The 2012 *ESPR* future scenarios are used to evaluate the potential cumulative environmental effects that could occur if Hanscom Field reaches the airport activity levels that are described in Chapter 3, Airport Activity Levels. The 2020 and 2030 scenarios are estimates of what *could* occur (not what *will occur*) in the future using certain planning assumptions and are not necessarily recommended outcomes. The future service scenarios are fully consistent with Massport's 1980 Regulations for Hanscom Field, which prohibit scheduled commercial passenger services with aircraft having more than 60 seats.

7.1 Key Findings Since 2005

In general, noise levels at Hanscom Field decreased over the last several years, due primarily to quieter and better performing aircraft and decreases in operations. The 2020 and 2030 scenarios, with the increases in general aviation (GA) jet activity to about 190,000 operations drive a projected increase in overall noise levels in the future though remaining below historical peak operations and reaching levels last experienced nearly a decade ago.

Massport has also made operational changes that have minimized noise impacts. In 2009, Massport began a new initiative to reduce noise over the Minute Man National Historical Park (MMNHP). Most touch-and-go operations circled to the south of the airport often taking the aircraft over areas of the Battle Road Trail that are used by the Park for outdoor programs and interpretive talks. A partnership of Massport, National Park Service (NPS), the Federal Aviation Administration (FAA), the flight schools and Hanscom pilots determined that small aircraft could increase the use of a tight touch-and-go pattern that keeps the aircraft over the airfield rather than over sensitive park areas. Using radar data, Massport staff monitors the number of touch-and-go operations over the MMNHP. This data is a critical part of ongoing quarterly meetings between Massport, FAA air traffic control tower, and flight school staff to review touch-and-go flight paths. Since the initiation of this program, flights over MMNHP have been reduced by an average of 21%.

Comparison of year 2012 DNL noise contours to 2005 contours shows that overall noise levels decreased. Modeled noise values for 2000 are also included in this section and demonstrate longer-term trends of decreasing noise. This is largely due to overall lower activity levels, lower activity levels by jets, much

lower activity by Stage 2 GA jets, and a decrease in nighttime operations. FAA land use compatibility guidelines, assume that individuals exposed to greater than 65 dB DNL are considered significantly affected by noise. None of the Hanscom Field noise analysis location sites is currently exposed to a DNL value above the FAA land use compatibility criterion of 65 dB.

Overall, noise levels have decreased from 2000 to 2005 and again in the base year 2012. With the forecasted level of aircraft operations, noise is anticipated to increase in 2020 over 2012 and then again in 2030. However, 2020 noise will remain lower than what was experienced in 2005, and 2030 noise will be comparable to 2005. The following statistics illustrate the decrease in noise:

- Total population exposed to DNL greater than 65 dB was reduced to zero in 2012 from 17 in 2005 (all in Bedford) and 26 in 2000. The total population in the four towns exposed to DNL values of 55 dB or greater decreased from 2,953 residents in 2005 (up slightly from 2,848 in 2000) to 1,041 in 2012 (see Table 7-1). While the 2030 scenario generates the highest noise levels of this analysis, in all future scenarios, there are no residents exposed to noise levels exceeding 65 dB or greater. Forecast noise levels for the 2030 scenario show increases in DNL up to 2 dB at some noise analysis locations. Table 7-1 presents the population estimates within the 65 and 55 DNL contours for 2000, 2005, 2012, and the 2020 and 2030 scenarios.

Table 7-1 Summary of U.S. Census Population Counts within DNL Contours

Year/Scenario	Population ¹	
	65 dB or Greater ²	55 dB or Greater ³
2000	26	2,848
2005	17	2,953
2012	0	1,041
2020	0	1,176
2030	0	1,859
Notes:		
1. Based on the 2010 U.S. Census except for 2005 which was computed for the 2005 <i>ESPR</i> using the 2000 U.S. Census		
2. These population estimates fall within the 65 and 70 DNL contours.		
3. These population estimates include population within the 55, 60, 65 and 70 DNL contours.		

- The few historic sites within the 60 DNL contour for the 2005 *ESPR* today have lower noise levels and there are no historic sites within the 65 DNL contour. There are only two historic sites that have DNL values greater than 55 dB in 2012: Deacon John Wheeler/Capt. Jonas Minot Farmhouse (NC-18) in Concord at 58.4 dBA, which had a DNL value of 60.4 dBA in 2005; and Wheeler-Meriam House (NC-19) in Concord at 58.1 dBA, which had a DNL value of 59.9 dBA in 2005. No noise analysis locations would experience a DNL value greater than 60 dB under any scenario. Three historic sites would experience noise levels between 55 and 60 dB: the Deacon John Wheeler/Capt. Jonas Minot Farmhouse in Concord would range from 58.7 dBA in the 2020 scenario to 59.8 dBA in the 2030 scenario; the Wheeler-Meriam House in Concord would range from 58.4 dBA in the 2020 scenario to 59.4 dBA in the 2030 scenario; and the Ripley School (SC-7) in Concord is forecast at 55.0 dBA in the 2030 scenario. None of the sites in the MMNHP would experience a DNL value greater than 55 dB for 2012 or any future scenario.
- No portion of the MMNHP is located in the 65 DNL contour in 2012 or in the 2020 and 2030 planning scenarios. Furthermore, no portion of the MMNHP is in the 55 DNL contour in 2012, down from 1.7 acres in 2005. MMNHP is not forecast to include any 55 DNL area in the 2020 planning scenario and 0.4 acres in the 2030 scenario.

7.2 Noise Terminology

Noise, often defined as unwanted sound, is an environmental issue associated with aircraft operations. Aircraft are not the only sources of noise in an urban or suburban environment where interstate and local roadway traffic, rail, industrial, and neighborhood sources also intrude on the everyday quality of life. Nevertheless, aircraft are readily identified by their noise and are typically singled out for special attention and criticism. Consequently, aircraft noise often dominates analyses of environmental impacts. To help understand and interpret these impacts, it is important to be familiar with the various metrics that are used to describe the noise from an aircraft and from the collection of noise events that comprise an airport noise environment. This introductory section describes those commonly used noise metrics, in increasing complexity. They include the:

- Decibel (dB)
- A-weighted decibel, or sound level (dBA)
- Sound Exposure Level (SEL)
- Equivalent Sound Level (L_{eq})
- Day-Night Sound Level (DNL)
- Total Noise Exposure (EXP)
- Time Above (TA)

The 2012 *ESPR* reports noise levels at Hanscom Field in terms of these metrics, including SELs for typical individual events, and Time Above contours and DNL contours for typical 24-hour exposure periods. All three of these metrics utilize A-weighted sound levels as their basic unit of measurement. The 2012 *ESPR* uses the highlighted metrics (i.e., SEL, EXP, and TA) to supplement DNL contours and DNL values at noise analysis locations. A discussion of the effects of aircraft noise on people is provided in Appendix D.

7.2.1 The Decibel (dB)

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air, and are sensed by the human ear. Whether that sound is interpreted as pleasant (e.g., music) or unpleasant (e.g., jackhammer) depends largely on the listener's current activity, experience, and attitude toward the source of that sound. It is often true that one person's music is another person's noise.

The loudest sounds the human ear can comfortably hear have one trillion (1,000,000,000,000) times the acoustic energy of sounds the ear can barely detect. Because of this vast range, any attempt to represent the intensity of sound using a linear scale becomes unwieldy. As a result, a logarithmic unit called the decibel is used to represent the intensity of sound. This representation is called a sound pressure level.

A sound pressure level of less than 10 dB is approximately the threshold of human hearing and is barely audible under extremely quiet conditions. Normal conversational speech has a sound pressure level of approximately 60 to 65 dB. Sound pressure levels above 120 dB begin to be felt inside the human ear as discomfort and eventually pain at still higher levels.

7.2.2 A-weighted Sound Level (dBA)

Additionally, not all sound pressures are heard equally well by the human ear. Some tones are easier to detect than others and are perceived as being louder or noisier. Thus, in measuring community noise, frequency dependence is taken into account by adjusting the very high and very low frequencies to

approximate the human ear's reduced sensitivity to those frequencies. This adjustment is called "A-weighting" and is commonly used in measurements of environmental noise.

Figure 7-1 shows A-weighted sound levels for some common sounds. In this document, all sound pressure levels are A-weighted and, as is customary, are referred to simply as "sound levels," where the adjective "A-weighted" has been omitted. Sound levels are designated in terms of A-weighted decibels, abbreviated dBA. With A-weighting, a noise source having a higher sound level than another is generally perceived as louder. Also, the minimum change in sound level that people can detect outside of a laboratory environment is on the order of 3 dB. A change in sound level of 10 dB is usually perceived by the average person as a doubling (or halving) of the sound's loudness, and this relationship remains so for loud sounds as well as for quieter sounds.

7.2.3 Sound Exposure Level (SEL)

A further complexity in judging the impact of a sound is how long it lasts. Long duration noises are more annoying than short ones. The period over which a noise is heard is accounted for in noise measurements and analyses by integrating sound pressures over time. In the case of an individual aircraft flyover, this can be thought of as accounting for the increasing noise of the airplane as it approaches, reaches a maximum, and then falls away to blend into the background (see Figure 7-2). The total noise dose, or exposure, resulting from the time-varying sound is normalized to a one-second duration so that exposures of different durations can be compared on an equal basis. This time-integrated level is known as the Sound Exposure Level, measured in A-weighted decibels.

Because aircraft noise events last longer than one second, the time-integrated SEL always has a value greater in magnitude than the maximum sound level of the event – usually about 7 to 10 dB higher for most airport environments. SELs are used in this study as a means of comparing the noise of several significant aircraft types; they are also highly correlated with sleep disturbance, an impact that is discussed in Appendix D.

The remaining noise metrics discussed in this section refer to the accumulation of exposure caused by multiple noise events over time. While such metrics are often viewed as downplaying the importance of individual aircraft operations, they are extremely good indicators of community annoyance with complex noise environments, and they have become widely accepted as the most appropriate means of evaluating land use planning decisions.

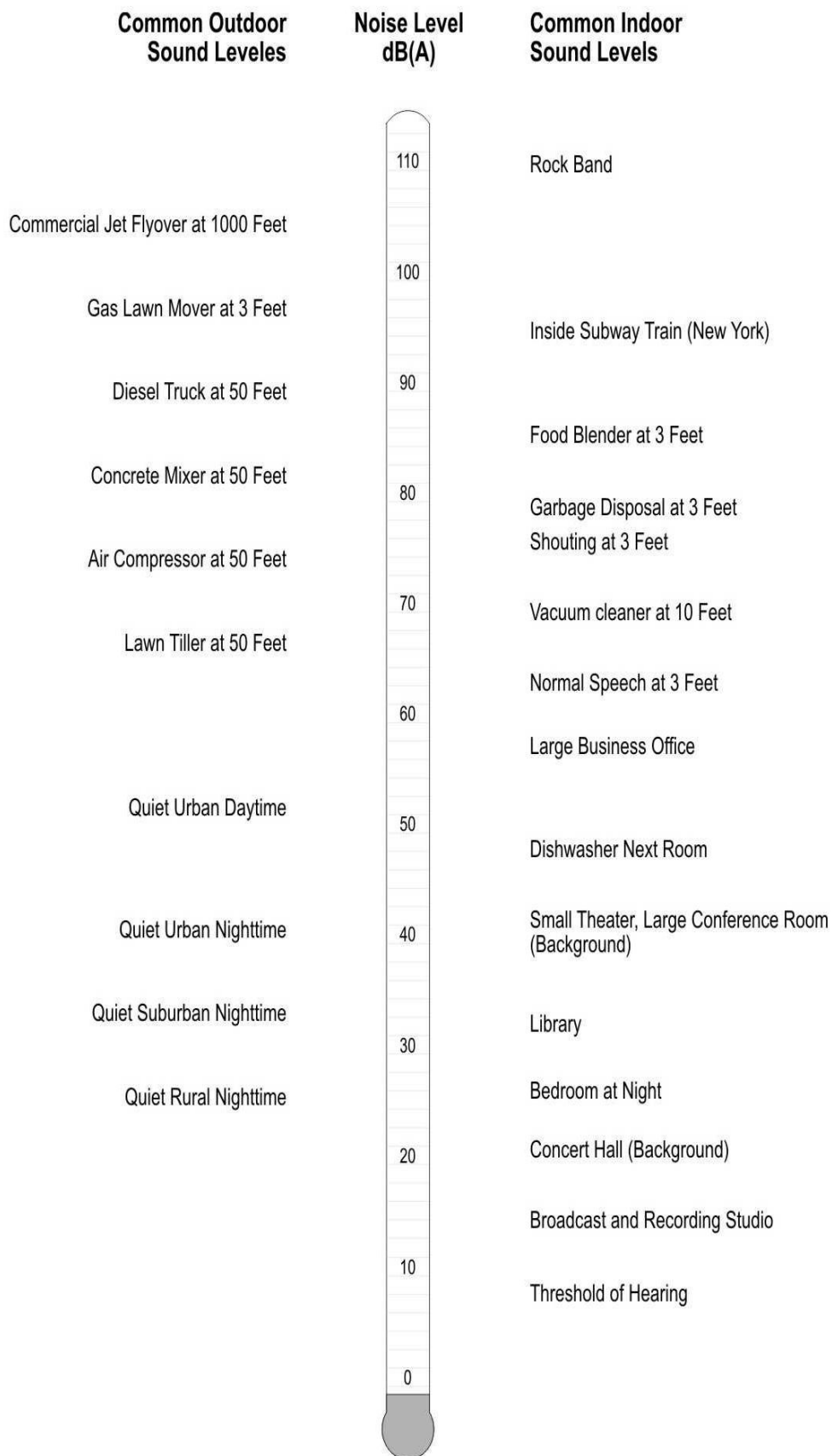


Figure 7-1 Common A-weighted Sound Levels

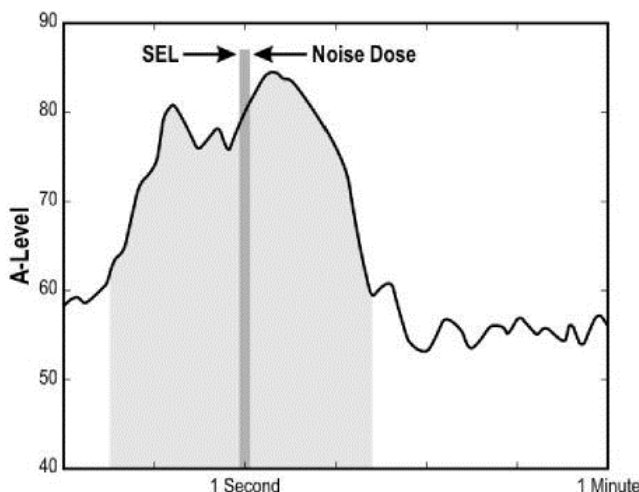


Figure 7-2 Illustration of Sound Exposure Level

7.2.4 Equivalent Sound Level (L_{eq})

The most basic measure of cumulative exposure is the Equivalent Sound Level. It is a measure of exposure resulting from the accumulation of A-weighted sound levels over a particular period (as opposed to an event) of interest such as an hour, an eight-hour school day, nighttime, a single 24-hour period, or an average 24-hour period. Because the length of the period can differ, the applicable period should always be identified or clearly understood when discussing the metric. Such durations are often identified through a subscript, for example $L_{eq}(8)$ or $L_{eq}(24)$.

Conceptually, the L_{eq} may be thought of as the constant sound level occurring over the designated period of interest and having as much sound energy as that created by the actual rising and falling sound pressures from multiple noise sources as they become more or less pronounced. This is illustrated in Figure 7-3 for the same representative one-minute of exposure shown earlier in Figure 7-2. Both the dark and light gray shaded areas have a one-minute L_{eq} value of 76 dBA. It is important to recognize, however, that the two representations of exposure (the constant one and the time-varying one) would sound very different from each other were they to occur in real life.

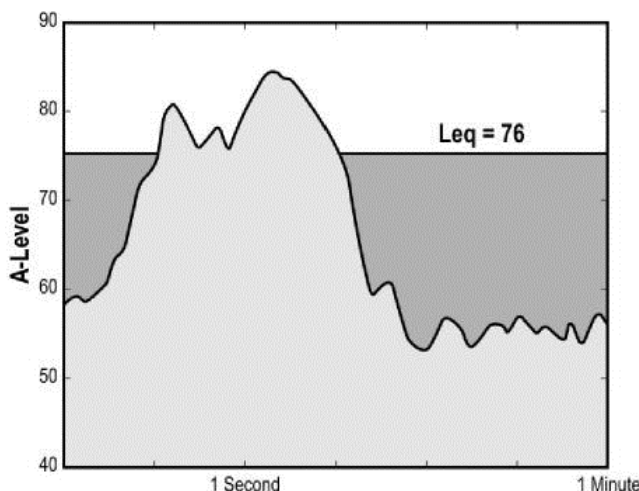


Figure 7-3 Illustration of Equivalent Sound Level

Often the L_{eq} is referred to misleadingly as an "average" sound level. This is not accurate in the traditional sense of the term average. Because decibels are logarithmic quantities, loud events dominate the

calculation of the L_{eq} . For example, if an aircraft produced a constant sound level of 85 dBA for 30 seconds of a minute then immediately disappeared, leaving only ambient noise sources to produce a level of 45 dBA for the remaining 30 seconds, the L_{eq} for the full minute would be 82 dBA – just 3 dBA below the maximum caused by the aircraft, not the 65 dBA suggested by normal averaging.

More typical timeframes of interest are daytime, nighttime, and annual average 24-hour exposure levels, but all of these same principles of combining sound levels apply to those periods as well. Loud noise events occurring during any timeframe are going to have the greatest influence on the overall exposure for the period.

7.2.5 The Day-Night Sound Level (DNL)

The most widely used cumulative noise metric is a variant of the 24-hour L_{eq} known as the Day-Night Sound Level, or DNL, a measure of noise exposure that is highly correlated with community annoyance. The long-term (yearly) average DNL is also associated with a variety of FAA land use guidelines that suggest where incompatibilities are expected to exist between the noise environment and various human activities. Because of these strengths, the metric is required to be used on airport noise studies funded by the FAA.

In simple terms, DNL is the equivalent sound level for a 24-hour period, modified so that noises occurring at night (defined specifically as 10:00 p.m. to 7:00 a.m.) are artificially increased by 10 dB. This "penalty" reflects the added intrusiveness of nighttime noise events as community activity subsides and ambient noise levels get quieter. The penalty is mathematically equivalent to multiplying the number of nighttime noise events by a factor of ten.

The U.S. Environmental Protection Agency (EPA) identified DNL as the most appropriate means of evaluating airport noise based on its criteria, as follows:³⁰

- The measure should be applicable to the evaluation of pervasive long-term noise in various defined areas and under various conditions over long periods of time.
- The measure should correlate well with known effects of the noise environment and on individuals and the public.
- The measure should be simple, practical and accurate. In principal, it should be useful for planning as well as for enforcement or monitoring purposes.
- The required measurement equipment, with standard characteristics, should be commercially available.
- The measure should be closely related to existing methods currently in use.
- The single measure of noise at a given location should be predictable, within an acceptable tolerance, from knowledge of the physical events producing the noise.
- The measure should lend itself to small, simple monitors, which can be left unattended in public areas for long periods of time.

Despite these origins, the lay public often criticizes the use of DNL as not accurately representing community annoyance and land use compatibility with aircraft noise. Much of that criticism stems from a lack of understanding of the measurement or calculation of DNL. One frequent criticism is based on the feeling that people react more to single noise events than to "meaningless" time-average sound levels. In

³⁰Environmental Protection Agency, Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, U.S EPA Report No. 550/9-74-004, September 1974.

fact, DNL takes into account both the noise levels of all individual events occurring during a 24-hour period and the number of times those events occur. The logarithmic nature of the decibel causes noise levels of the loudest events to control the 24-hour average, just as they were shown to do in the previous discussion of shorter-term L_{eqS} .

Most federal agencies dealing with noise have formally adopted DNL, though they also encourage the use of supplemental noise metrics to aid the public in understanding the complex noise environment of an airport. For example, Massport frequently uses the Sound Exposure Level, maximum sound level, or times above threshold sound levels to help describe the environments around Hanscom Field and Logan International Airport.

Even so, the Federal Interagency Committee on Noise (FICON), comprising of member agencies such as the FAA, Department of Defense (DoD), U.S. EPA, Department of Housing and Urban Development (HUD), National Aeronautics and Space Administration (NASA), Council on Environmental Quality (CEQ), and the Department of Veterans Affairs, reaffirmed the appropriateness of DNL in 1992. The FICON summary report stated, "There are no new descriptors or metrics of sufficient scientific standing to substitute for the present DNL cumulative noise exposure metric".³¹ The Federal Interagency Committee on Aviation Noise (FICAN) recently supported the use of supplemental metrics in its statement that "supplemental metrics provide valuable information that is not easily captured by DNL".³²

DNL can be measured or estimated. Measurements are practical only for obtaining DNL values for a relatively limited number of points, and, except in the case of a permanently installed noise monitoring system, only for relatively short time periods. Most airport noise studies are based on computer-generated DNL estimates, depicted in terms of equal-exposure noise contours, much as topographic maps have contours of equal elevation.

7.2.6 Total Noise Exposure (EXP)

The EXP metric was developed in 1982 as a screening tool for Massport to assess changes in the fleet mix of aircraft operating at Hanscom Field over time. Although EXP does not show how noise levels change in specific communities, it does indicate changes in total noise exposure and expected resultant changes in DNL, without the need to prepare noise contours. The 2012 EXP uses the FAA aircraft noise database from the most recent version of the INM, version 7.0c. This is an upgrade over INM 6.1 which has been used to compute EXP since the 2005 *ESPR*.

This supplemental metric is calculated by logarithmically summing the representative SELs for each departure of an airplane assuming it flies over a single point on the ground. Similar aircraft types are grouped together in the calculations, creating a "partial EXP" for the group. Partial EXP values for each group are then summed to obtain a single number estimate of departure noise exposure at that reference location. Similar calculations are performed for arrival operations. Separate computations are performed for civil and military operations.

Massport maintains a comprehensive database of operations conducted by aircraft heavier than single engine piston aircraft. EXP uses the same summation formula as DNL: logarithmic summation of all

³¹Federal Interagency Committee on Noise, Federal Agency Review of Selected Airport Noise Analysis Issues, August 1992.

³²Federal Interagency Committee on Aviation Noise, The Use of Supplemental Noise Metrics in Aircraft Noise Analyses, February 2002.

noise events over a 24-hour day, with a 10 dB penalty applied to events occurring between 10:00 p.m. and 7:00 a.m.

7.2.7 Time Above a Threshold (TA)

Because analyses of decibels are complex and often unfamiliar to the public, the FAA has developed a supplemental noise metric that is non-logarithmic: the amount of time (in minutes or seconds) that the noise source of interest exceeds a given A-weighted sound level threshold. Every time a noise event goes above a given threshold, the number of seconds is accumulated and added to any previous periods that the noise exceeded the threshold. These time-above-thresholds, or Time Above, are usually reported for a 24-hour period.

Note that Time Above does not tell the loudness of the various noise events. Just as a single value of the A-weighted sound level ignores the dimension of time, so the Time Above ignores the dimension of loudness. Nevertheless, Time Above can be helpful in better understanding a noise environment.

7.3 Year 2012 Noise Prediction Methodology

This section documents the noise prediction methodology for preparing DNL and Time Above calculations for 2012 and discusses changes in the FAA's Integrated Noise Model (INM). The INM is a complex computer program that calculates aircraft noise levels around an airport from user input data and an extensive internal database of aircraft noise and performance statistics. Outputs can include DNL contours and other metrics such as Time Above and DNL values at specific points.

The FAA developed the INM as the primary tool for analyzing and evaluating noise impacts from aircraft operations. Its use is prescribed for all FAA-sponsored projects requiring environmental evaluation. The INM contains a set of noise and profile databases, which can be altered by the analyst to enable input of data for new aircraft and engine types, and account for specific changes in flight procedures. The FAA requires that any changes to these databases be approved prior to use on any FAA-related project.

The preparation of airport noise exposure contours requires compilation of several categories of information about the operation of an airport:

- Airfield Geometry – Location, length, orientation, elevation, and thresholds of all runways
- Flight Tracks – Paths followed by aircraft departing from, or arriving to, each runway
- Runway Use – Percentage of operations by each type of aircraft that occur on each runway
- Flight Track Usage – Percentage of operations by each aircraft type that use each flight track
- Operations Numbers – Numbers of departures, arrivals, and pattern operations by each type of aircraft during the year
- Aircraft Noise and Performance – Specific noise and performance data must be entered for each aircraft.

The INM interprets this input and computes the noise exposure around an airport as a grid of values for many different metrics including the DNL. The grid information is the input for a contouring program. This study used the most recent version of the INM at the time of analysis, Version 7.0c (INM 7.0c).

7.3.1 Physical Input

The first two categories of INM input, airport layout and flight tracks, are categorized as the physical input. They determine the paths on the runways and in the air where the aircraft travel in the noise model.

7.3.1.1 Airfield Geometry

The layout of an airfield is an important modeling input. Accurate runway information places modeled flights in the correct locations. Elevation data allow the INM to calculate runway gradients, which influence modeled take-off roll and landing distances. The runway end locations, elevations, displaced thresholds and the location and elevation of the airport reference point were taken from the FAA's Form 5010 airport data system. The Form 5010 data do not contain a helipad nor does Hanscom have a designated helipad, though helicopters operate at Hanscom Field. The location of a representative helipad was chosen through the examination of helicopter radar tracks, aerial photographs, and the FAA airport diagram. This is discussed in the section on Runway Use.

7.3.1.2 Flight Tracks

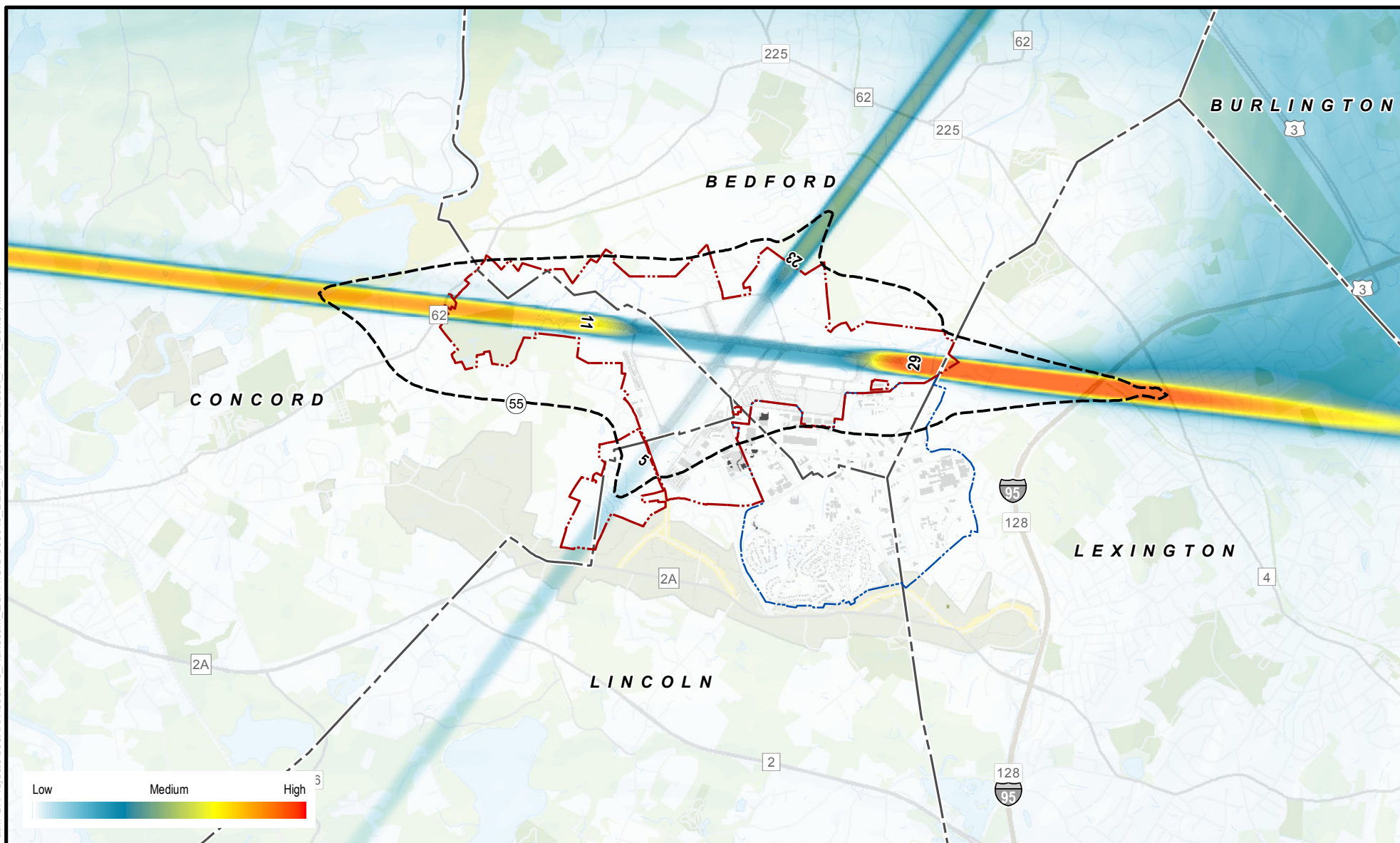
Flight tracks represent the ground projection of paths flown by aircraft at an airport. In previous ESPRs, the very broad range of operations and conditions actually occurring at Hanscom were represented using a set of average or model tracks. For the 2012 *ESPR*, every individual flight track from Massport's NOMS was used. HMMH prepared the 2012, 2020, and 2030 contours using an INM pre-processor, named RealContours™. RealContours converts aircraft flight track data into FAA's INM input data, runs the INM, and provides the INM results based on the modeling of each individual flight track. RealContours prepares each available aircraft flight track during the course of the year for input into INM.

Flight tracks were provided from Massport's NOMS. In summary, 71,363 individual flight tracks were directly used for the preparation of the 2012 contours and the operations were scaled to the 167,845 operations total. The difference between the number of flight tracks modeled and the total operations counts are expected and can occur because RealContours filters data to make sure it is suitable for modeling. Each flight track must meet several criteria, including having a runway assignment, valid aircraft type designator and enough suitable flight track points. The most important of these factors at Hanscom is the presence of a valid aircraft type designator. Operations by piston aircraft are often unidentified in the radar data. Over 70,000 local and over 50,000 itinerant operations were conducted by piston aircraft at Hanscom in 2012. The over 40,000 valid radar tracks modeled in the *ESPR* for these aircraft represent an excellent sample showing the distribution of flight paths off of all runway ends.

It should be emphasized that the INM is used for all noise calculations. RealContours provides an organizational structure to model individual flight tracks in INM.

Figure 7-4 and Figure 7-5 present density plots for jet arrivals and departures in and out of Hanscom Field. Figure 7-6 and Figure 7-7 are arrival and departure density plots for propeller aircraft, including piston propeller aircraft, turbo-propeller aircraft, and helicopters. Figure 7-8 shows the tracks for the touch-and-go activity by light propeller aircraft. Areas of red represent the highest density of flight paths. Areas of blue show the lowest density. Appendix D provides additional flight track graphics, showing samples of the individual flight paths for jet aircraft arrivals and departures, propeller aircraft arrivals and departures, and touch-and-go tracks by propeller aircraft.

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- | | | | | | |
|--|---------------------------------|--|---------------------|--|------------------------------------|
| | 2012 - 55 dB DNL Contour | | Historic Road | | MMNHP Boundary |
| | Hanscom Field Property Boundary | | Interstate | | Great Meadows |
| | Hanscom AFB Property Boundary | | Highway | | Open Space Non-protected |
| | Municipal Boundary | | Road | | Open Space Protected in Perpetuity |
| | | | Trail | | Open Water |
| | | | Active Rail Service | | Stream |



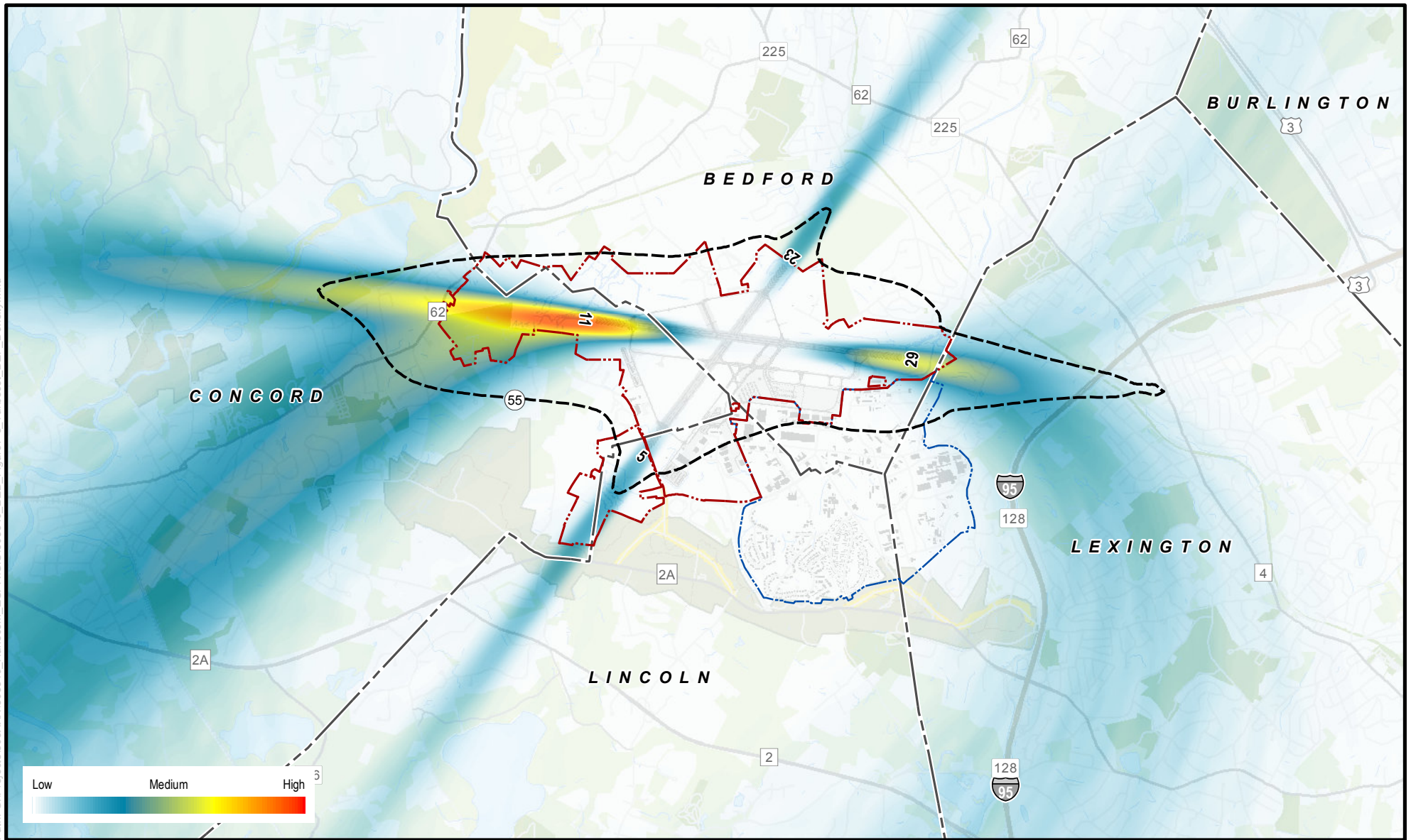
Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Turbojet Radar Track Density Plot - Arrivals

Data Sources: MassGIS (Roads, Rail), March 5, 2013; MassGIS (Bike Trails, Tracks and Trails), March 7, 2013;
MassGIS (Community Boundaries), March 5, 2013; MassGIS (DEP Wetlands), March 8, 2013;
NPS (Park Boundary), March 8, 2013; NPS (Streets and Trails), March 8, 2013; MassGIS (Building Footprints), March 7, 2013

Figure 7-4

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- | | | | | | |
|--|---------------------------------|--|---------------------|--|------------------------------------|
| | 2012 - 55 dB DNL Contour | | Historic Road | | MMNHP Boundary |
| | Hanscom Field Property Boundary | | Interstate | | Great Meadows |
| | Hanscom AFB Property Boundary | | Highway | | Open Space Non-protected |
| | Municipal Boundary | | Road | | Open Space Protected in Perpetuity |
| | | | Trail | | Open Water |
| | | | Active Rail Service | | Stream |



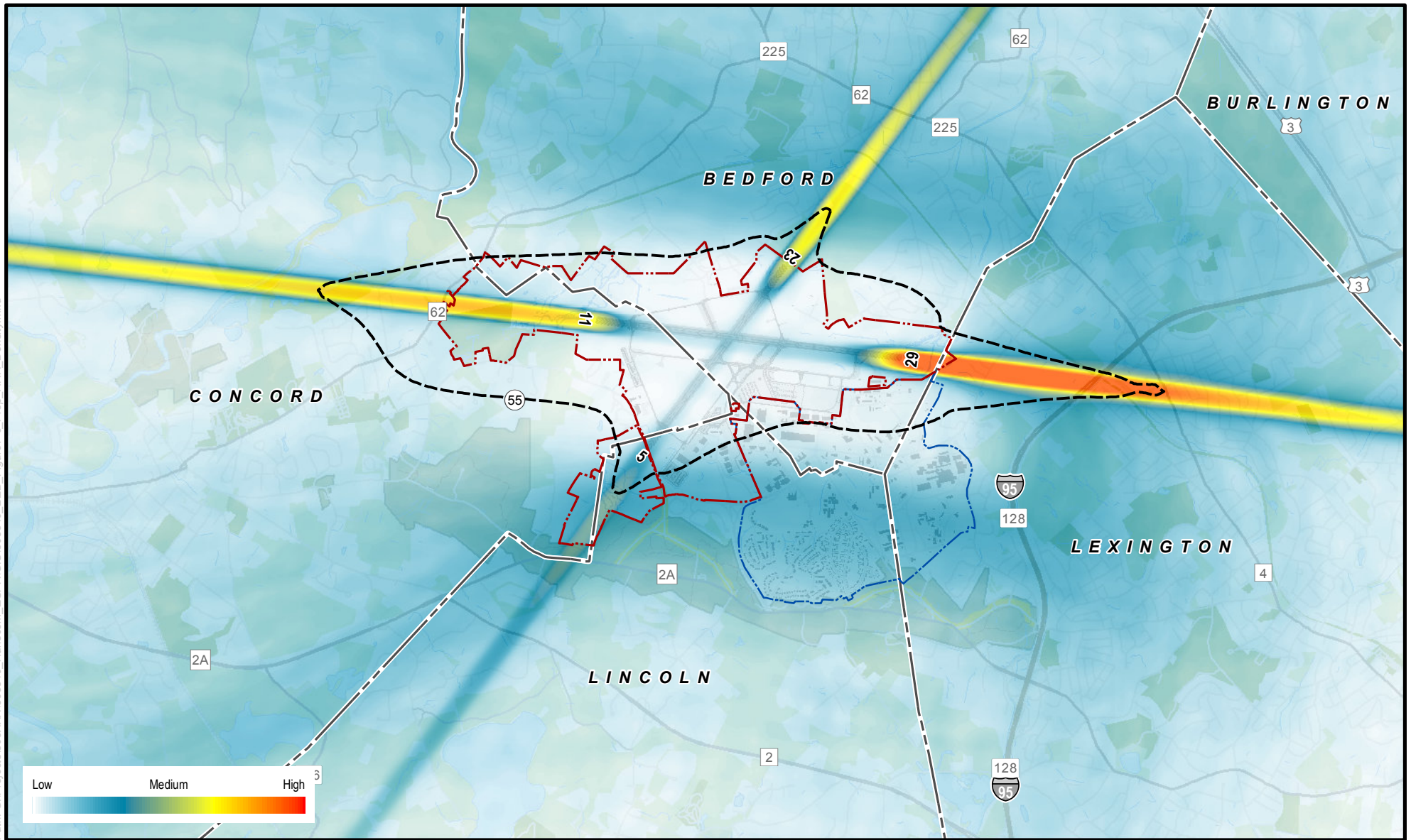
Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Turbojet Radar Track Density Plot - Departures

Data Sources: MassGIS (Roads, Rail), March 5, 2013; MassGIS (Bike Trails, Tracks and Trails), March 7, 2013; MassGIS (Community Boundaries), March 5, 2013; MassGIS (DEP Wetlands), March 8, 2013; NPS (Park Boundary), March 8, 2013; NPS (Streets and Trails), March 8, 2013; MassGIS (Building Footprints), March 7, 2013

Figure 7-5

Path: G:\Projects\305540_Hanscom_ESPR\GIS\305540_BED_Figure7-6_Prop_ARR_Density.mxd



- | | | |
|---------------------------------|---------------------|------------------------------------|
| 2012 - 55 dB DNL Contour | Historic Road | MMNHP Boundary |
| Hanscom Field Property Boundary | Interstate | Great Meadows |
| Hanscom AFB Property Boundary | Highway | Open Space Non-protected |
| Municipal Boundary | Road | Open Space Protected in Perpetuity |
| | Trail | Open Water |
| | Active Rail Service | Stream |



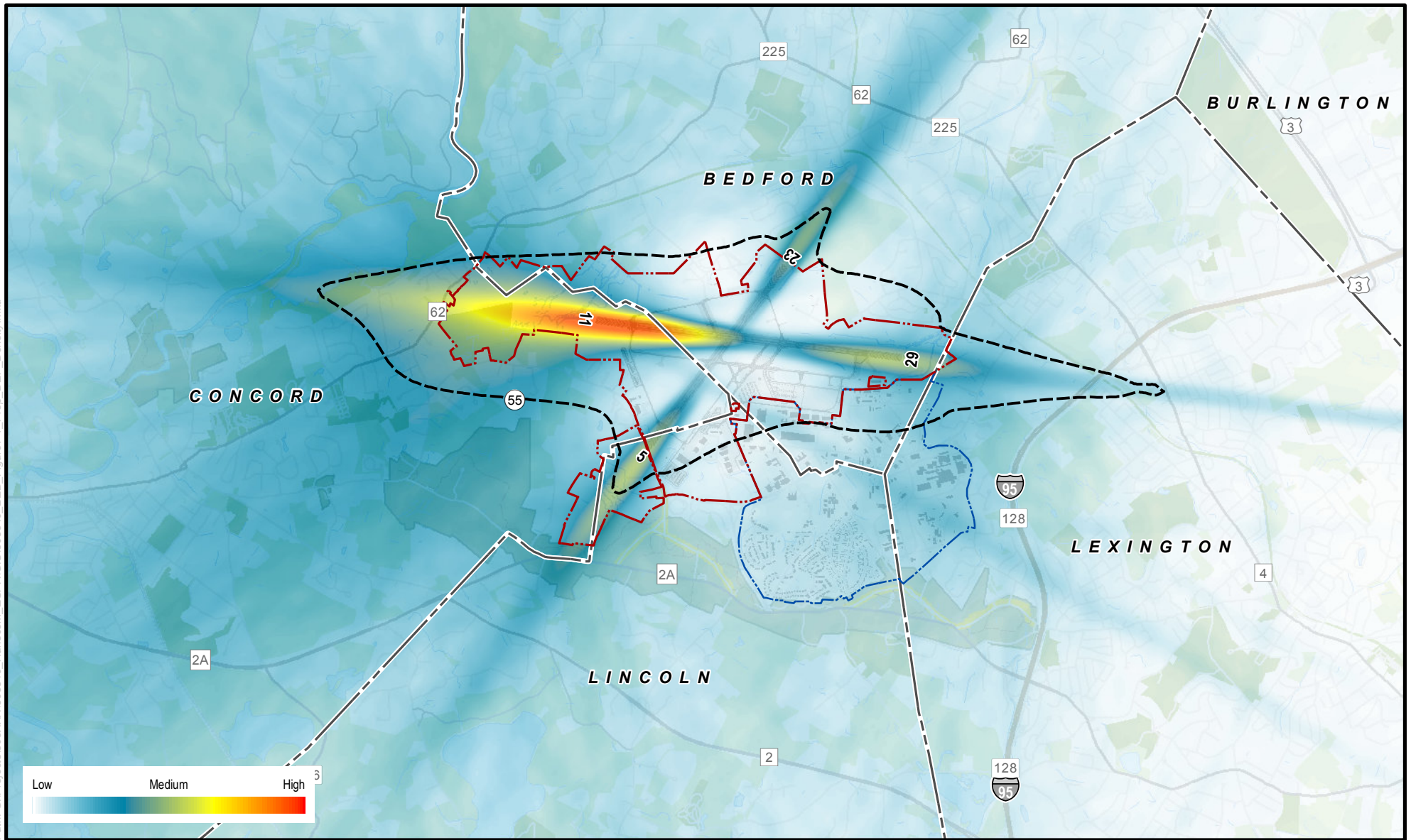
Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Propeller Aircraft Radar Track Density Plot - Arrivals

Data Sources: MassGIS (Roads, Rail), March 5, 2013; MassGIS (Bike Trails, Tracks and Trails), March 7, 2013;
MassGIS (Community Boundaries), March 5, 2013; MassGIS (DEP Wetlands), March 8, 2013;
NPS (Park Boundary), March 8, 2013; NPS (Streets and Trails), March 8, 2013; MassGIS (Building Footprints), March 7, 2013

Figure 7-6

Path: G:\Projects\305540_Hanscom_ESPR\GIS\305540_BED_Figure7-7 Prop_DEP_Density.mxd



- | | | |
|---------------------------------|---------------------|------------------------------------|
| 2012 - 55 dB DNL Contour | Historic Road | MMNHP Boundary |
| Hanscom Field Property Boundary | Interstate | Great Meadows |
| Hanscom AFB Property Boundary | Highway | Open Space Non-protected |
| Municipal Boundary | Road | Open Space Protected in Perpetuity |
| | Trail | Open Water |
| | Active Rail Service | Stream |



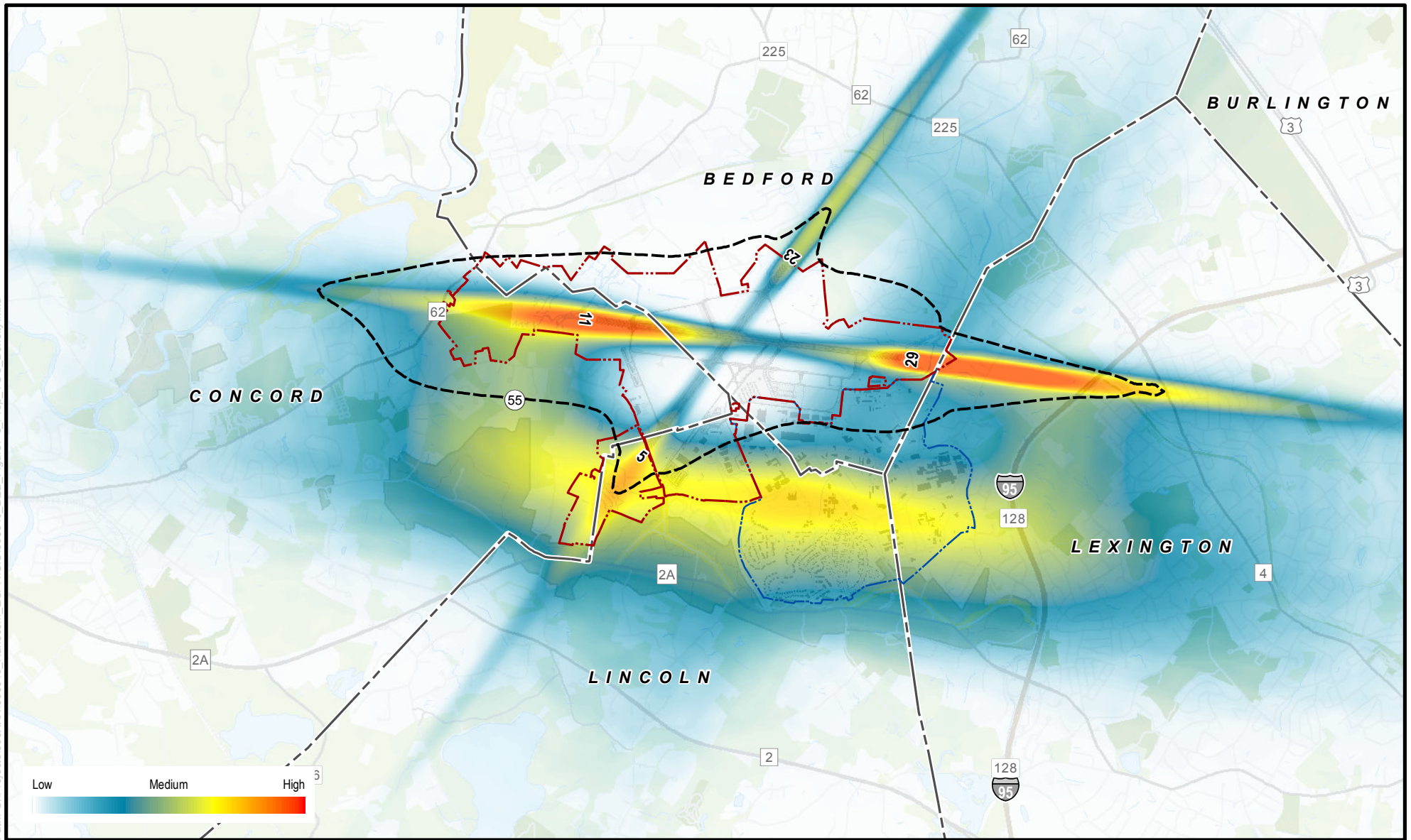
Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Propeller Aircraft Radar Track Density Plot - Departures

Data Sources: MassGIS (Roads, Rail), March 5, 2013; MassGIS (Bike Trails, Tracks and Trails), March 7, 2013;
MassGIS (Community Boundaries), March 5, 2013; MassGIS (DEP Wetlands), March 8, 2013;
NPS (Park Boundary), March 8, 2013; NPS (Streets and Trails), March 8, 2013; MassGIS (Building Footprints), March 7, 2013

Figure 7-7

Path: G:\Projects\3055540_Hanscom_ESPR\GIS\305540_BED_Figure7-8_Prop_TGO_Density.mxd



- 2012 - 55 dB DNL Contour
- Hanscom Field Property Boundary
- Hanscom AFB Property Boundary
- Municipal Boundary

- Historic Road
- Interstate
- Highway
- Road
- Trail
- Active Rail Service

- MMNHP Boundary
- Great Meadows
- Open Space Non-protected
- Open Space Protected in Perpetuity
- Open Water
- Stream



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Propeller Aircraft Radar Track Density Plot - Touch and Go

Data Sources: MassGIS (Roads, Rail), March 5, 2013; MassGIS (Bike Trails, Tracks and Trails), March 7, 2013; MassGIS (Community Boundaries), March 5, 2013; MassGIS (DEP Wetlands), March 8, 2013; NPS (Park Boundary), March 8, 2013; NPS (Streets and Trails), March 8, 2013; MassGIS (Building Footprints), March 7, 2013

Figure 7-8

7.3.2 Operational Input

The remaining INM input falls under the category of operational input and includes runway use, operations, and aircraft noise and performance data. These data determine the number, type, flight time, and other characteristics of the aircraft traveling on the paths defined in the physical input.

7.3.2.1 Runway Use

The operational runway use of the airport is a critical component in the computer modeling of aircraft noise. As described in section 7.3.1.2, all valid individual flight tracks from Massport's NOMS for the entire year of 2012 were used in the noise modeling. This large sample of over 70,000 flight tracks provides an excellent estimate of runway use for 2012 at Hanscom. For reporting purposes, each flight track was assigned to a category based on the type of propulsion and size of the aircraft. Once in these categories, the data were used to calculate runway use percentages.

Table 7-2 through Table 7-6 show the calculated runway use by operation and aircraft group. Helicopter runway use is not included in Table 7- through Table 7-6. Table 7-6 Touch-and-Go Runway Utilization is not differentiated by aircraft group as all pattern activity was modeled by using piston aircraft.

Many of the helicopters in the radar sample followed runway headings on arrival and dispersed quickly off of the runway centerline after departure, similar to light propeller aircraft. However, with their maneuverability, helicopters often hover along taxiways and depart or land from ramp areas as well as runway ends, and no hard data on arrival and departure locations on the airfield are maintained, by Massport or the FAA. To simplify the modeling of these conditions, helicopter operations were assumed to originate or terminate at a single point just north of the control tower. The remainder of the modeled flight path was fully defined by the radar flight track.

Table 7-2 Daytime (7:00 a.m. to 10:00 p.m.) Departure Runway Utilization

Runway	Aircraft Group				
	Stage 2 Corporate Jet	Stage 3 Corporate Jet	Large Jet	Turboprop	Piston
05	4.5%	4.4%	1.8%	9.7%	7.5%
11	18.2%	22.9%	23.9%	22.6%	14.7%
23	0.0%	4.5%	2.8%	6.9%	12.9%
29	77.4%	68.3%	71.5%	60.8%	64.9%

Source: Massport Noise and Operations Monitoring System flight tracks

Table 7-3 Nighttime (10:00 p.m. to 7:00 a.m.) Departure Runway Utilization

Runway	Aircraft Group				
	Stage 2 Corporate Jet	Stage 3 Corporate Jet	Large Jet	Turboprop	Piston
05	0.0%	6.4%	0.0%	9.2%	32.3%
11	0.0%	21.2%	29.4%	20.9%	19.3%
23	0.0%	1.1%	1.5%	0.0%	7.0%
29	100.0%	71.3%	69.0%	69.9%	41.4%

Source: Massport Noise and Operations Monitoring System flight tracks

Table 7-4 Daytime (7:00 a.m. to 10:00 p.m.) Arrival Runway Utilization

Runway	Aircraft Group				
	Stage 2 Corporate Jet	Stage 3 Corporate Jet	Large Jet	Turboprop	Piston
05	0.0%	1.2%	0.4%	1.1%	3.9%
11	17.0%	28.7%	28.7%	25.5%	20.2%
23	5.5%	8.5%	4.7%	13.7%	13.4%
29	77.5%	61.7%	66.2%	59.6%	62.5%

Source: Massport Noise and Operations Monitoring System flight tracks

Table 7-5 Nighttime (10:00 p.m. to 7:00 a.m.) Arrival Runway Utilization

Runway	Aircraft Group				
	Stage 2 Corporate Jet	Stage 3 Corporate Jet	Large Jet	Turboprop	Piston
05	0.0%	0.4%	0.0%	2.4%	4.5%
11	33.3%	54.1%	49.8%	38.7%	36.8%
23	0.0%	2.5%	0.2%	10.0%	10.8%
29	66.7%	43.1%	50.0%	48.9%	47.9%

Source: Massport Noise and Operations Monitoring System flight tracks

Table 7-6 Touch-and-Go Runway Utilization

Runway	Daytime (7:00 a.m. to 10:00 p.m.)	Nighttime (10:00 p.m. to 11:00 pm)
05	3.3%	0.0%
11	13.1%	27.6%
23	12.0%	14.9%
29	71.6%	57.4%
Note: 1. Touch-and-go operations are not allowed from 11:00 p.m. to 7:00 a.m. 2. Aircraft other than single engine pistons are not allowed to perform touch-and-go operations.		

Source: Massport Noise and Operations Monitoring System flight tracks

7.3.2.2 Operations

Massport's database of operations at Hanscom Field described in the EXP section provided the information necessary for the calculation of the average daily operations by aircraft type for 2012. Table 7-7 presents a summary of the 2012 operations modeled for the noise analysis. Appendix D provides a refined breakdown of the activity by individual aircraft types with their corresponding noise model representation.

Table 7-7 Year 2012 Average Daily Operations Summary by Group

Group	Departures		Arrivals		Total
	Daytime (7:00 a.m. to 10:00 p.m.)	Nighttime (10:00 p.m. to 7:00 a.m.)	Daytime (7:00 a.m. to 10:00 p.m.)	Nighttime (10:00 p.m. to 7:00 a.m.)	
Stage 2 Jets	0.2	0.0	0.2	0.0	0.4
Stage 3 Jets	31.7	1.6	30.8	2.6	66.7
Turboprops	4.4	0.1	4.4	0.1	9.1
Piston	177.5	0.5	177.2	0.8	356.1
Military	0.3	0.0	0.3	0.0	0.6
Helicopters	10.0	0.2	9.9	0.2	20.4
All Groups	224.1	2.5	222.9	3.7	453.2

Source: Massport, HMMH

7.3.2.3 Aircraft Noise and Performance Data

Specific noise and performance data are necessary for each aircraft type to be modeled. Noise data are included in the form of SELs at a range of distances (from 200 feet to 25,000 feet) from a particular aircraft with engines at a specific thrust level. Performance data include thrust, speed, and altitude profiles for takeoff and landing operations. The INM database contains standard noise and performance data for 274 different fixed wing aircraft types, most of which are civil aircraft. The INM also has 271 substitutions for aircraft that are not specifically defined in the INM database.

The program automatically accesses the applicable noise and performance data for departure and approach operations by those aircraft. For aircraft not included in the database, aircraft with incomplete information in the database, or aircraft using non-standard flight profiles, the data must be manually entered into the model. Due to the addition of new data for many aircraft in the INM database since the last study, there were no such non-standard aircraft included in this study.

7.3.3 Noise Model Differences

All noise calculations in the 2012 *ESPR* were prepared with INM 7.0c, which was the most current version available at the time of the analysis. The 2005 *ESPR* calculations used INM 6.1. The prior analyses of EXP were prepared with previous versions: Version 3.9 was used from 1987 through 1996, and Version 5.1 was used from 1996 through 1999. Table 7-8 summarizes some of the major differences between the different versions of the INM.

Table 7-8 Differences between Versions of the Integrated Noise Model

Version	Release Date	Updates/Enhancements over Previous Version	Massport Use
3.9	May 1987		First use of INM by Massport at Hanscom Field.
3.10	June 1992	<ul style="list-style-type: none"> Updated noise and performance data for all aircraft included in the previous database Eighteen new aircraft types. No computational changes between Versions 3.9 and 3.10. 	Massport continued to use INM 3.9 for consistency with prior calculations of EXP.
4.11	December 1993	<ul style="list-style-type: none"> Noise calculation improvements Expanded database Incorporation of algorithms that alter aircraft performance assumptions depending on user-defined temperature and airport elevation parameters. 	Massport continued to use INM 3.9 for consistency with prior calculations of EXP.
5.0	August 1995	<ul style="list-style-type: none"> New graphics user interface New data preparation and data input aids New graphics and plotting capabilities Improved and faster noise calculation algorithms 	Massport upgraded to this version for noise calculations in the 1995 GEIR.
5.1	February 1997	<ul style="list-style-type: none"> Incorporation of parts of the preprocessor program and access to NOISEMAP (USAF) data. 	Massport upgraded to this version for new calculations of EXP beginning with 1996.
5.2	May 1998	<ul style="list-style-type: none"> Three new aircraft and twenty new substitution aircraft Data for four aircraft modified to correct various problems. 	Massport continued to use INM 5.1 for consistency with prior calculations of EXP.
6.0	October 1999	<ul style="list-style-type: none"> First release in a new series of the INM. One new aircraft type Many algorithm improvements, including the ability to take atmospheric absorption into account. New version of the contour plotting program, NMPlot Addition of several new options to the model 	Massport continued to use INM 5.1 for consistency with prior calculations of EXP.

Version	Release Date	Updates/Enhancements over Previous Version	Massport Use
6.0a	May 2000	<ul style="list-style-type: none"> Noise and performance data for the Airbus 340 and Embraer 120 	Massport continued to use INM 5.1 for consistency with prior calculations of EXP.
6.0b	January 2001	<ul style="list-style-type: none"> Noise and performance data for the Airbus 330, Boeing 737-700, the Cessna Citation 550 Bravo and several Cessna piston engine aircraft 	Massport continued to use INM 5.1 for consistency with prior calculations of EXP.
6.0c	September 2001	<ul style="list-style-type: none"> Noise and performance data for the A319-121 and A320-232; the Boeing 717-200, 777-300, and 767-400; the Cessna Citation X; and the Gulfstream GII, GIII, GIV, and GV 	Massport upgraded to this version for noise calculations in the 2000 <i>ESPR</i> and for new calculations of EXP.
6.1	March 2003	<ul style="list-style-type: none"> New lateral attenuation algorithms that increase the sideline noise levels of aircraft with wing mounted engines Updated noise data for 114 of 115 military aircraft and added new profiles for 84 military aircraft Noise and performance data for 15 commercial aircraft 	Massport upgraded to this version for noise calculations in the 2005 <i>ESPR</i> and for new calculations of EXP.
6.2	May 2006	<ul style="list-style-type: none"> Updated noise and performance data for the Boeing 757-200 (PW and RR), 737-700, 777-200, and 747-400 Noise and performance data for the Piper PA28-161 Warrior, PA30 Twin Comanche, and PA31 Navajo, Raytheon Beech 1900D, Maule M-7-235, Eurocopter EC-130, and Robinson R-22 	Massport continued to use INM 6.1 for consistency with prior calculations of EXP.
6.2a	November 2006	<ul style="list-style-type: none"> Updated noise and/or profile information for nine Airbus aircraft, three MD80 series aircraft, and three Boeing 737 aircraft 	Massport continued to use INM 6.1 for consistency with prior calculations of EXP.
7.0	May 2007	<ul style="list-style-type: none"> Complete integration of helicopters New algorithms to compute lateral attenuation, determine noise due to thrust reverse, and account for aircraft bank angle 	Massport continued to use INM 6.1 for consistency with prior calculations of EXP.
7.0a	October 2008	<ul style="list-style-type: none"> Updates to noise/performance data for commercial aircraft Updates to substitutions, including several Piper aircraft Noise and performance data for the first Very Light Jet (VLJ) to be added to the INM database: the Cessna Mustang Model 510 	Massport continued to use INM 6.1 for consistency with prior calculations of EXP.
7.0b	September 2009	<ul style="list-style-type: none"> Noise and performance data for fourteen new aircraft including the Airbus A-380, two CRJ models, the Eclipse 500 VLJ, and three helicopters Updated aircraft performance data 	Massport continued to use INM 6.1 for consistency with prior calculations of EXP.
7.0c	January 2012	<ul style="list-style-type: none"> Updated noise data for nineteen aircraft Updated substitutions for sixty-eight aircraft revised profiles for twenty-one aircraft Noise and performance data for eleven new aircraft, including five Cessna jets, four Bell helicopters, and two single engine floatplanes 	Massport upgraded to version 7.0c for noise calculations in the 2012 <i>ESPR</i> and for new calculations of EXP

The EXP for 2012 was computed in both INM 6.1 and INM 7.0c to aid in comparing current and future calculations of EXP to past values. Civil Departure EXP, used to track trends in total noise exposure at Hanscom, was 108.4dB INM 6.1 and 107.4 dB for INM 7.0c. This difference reflects improvements in the INM's database of general aviation jets.

Thirty-four of the EXP aircraft groups had changes to their SELs plus or minus 1.0 dB or less. Four aircraft groups had changes ranging from minus 7.9 dB to plus 6.5 dB due to changing the INM aircraft which represents the group. These changes were primarily due to recent updates in the FAA recommended substitutions. The two helicopters, the civil SA365N and the military S70, changed by minus 4.1 dB and plus 7.7 dB, respectively, due to changes in the INM's noise and performance database. Additionally, five new EXP groups, all Cessna jets, were added due to the addition of these types to the

INM. These five aircraft represent thirteen percent of the non-single engine piston civil operations in 2012 and have been previously been assigned to other aircraft groups using FAA recommended substitutions.

7.4 Year 2012 Noise Levels

Noise exposure levels resulting from 2012 operations at Hanscom Field are depicted in terms of DNL contours in Figure 7-9. The figure shows contour values from 55 to 70 dB in 5 dB increments. DNL contours are a graphical representation of how the noise from Hanscom Field's aircraft operations is distributed over the surrounding area on an average day of a given year. The 2005 *ESPR* DNL contours are included in Figure 7-9 for comparison. Table 7-9 presents the acreage within each contour for 2005 and 2012 and indicates a general reduction in the size of the 2012 contours as compared with the 2000 and 2005 contours.

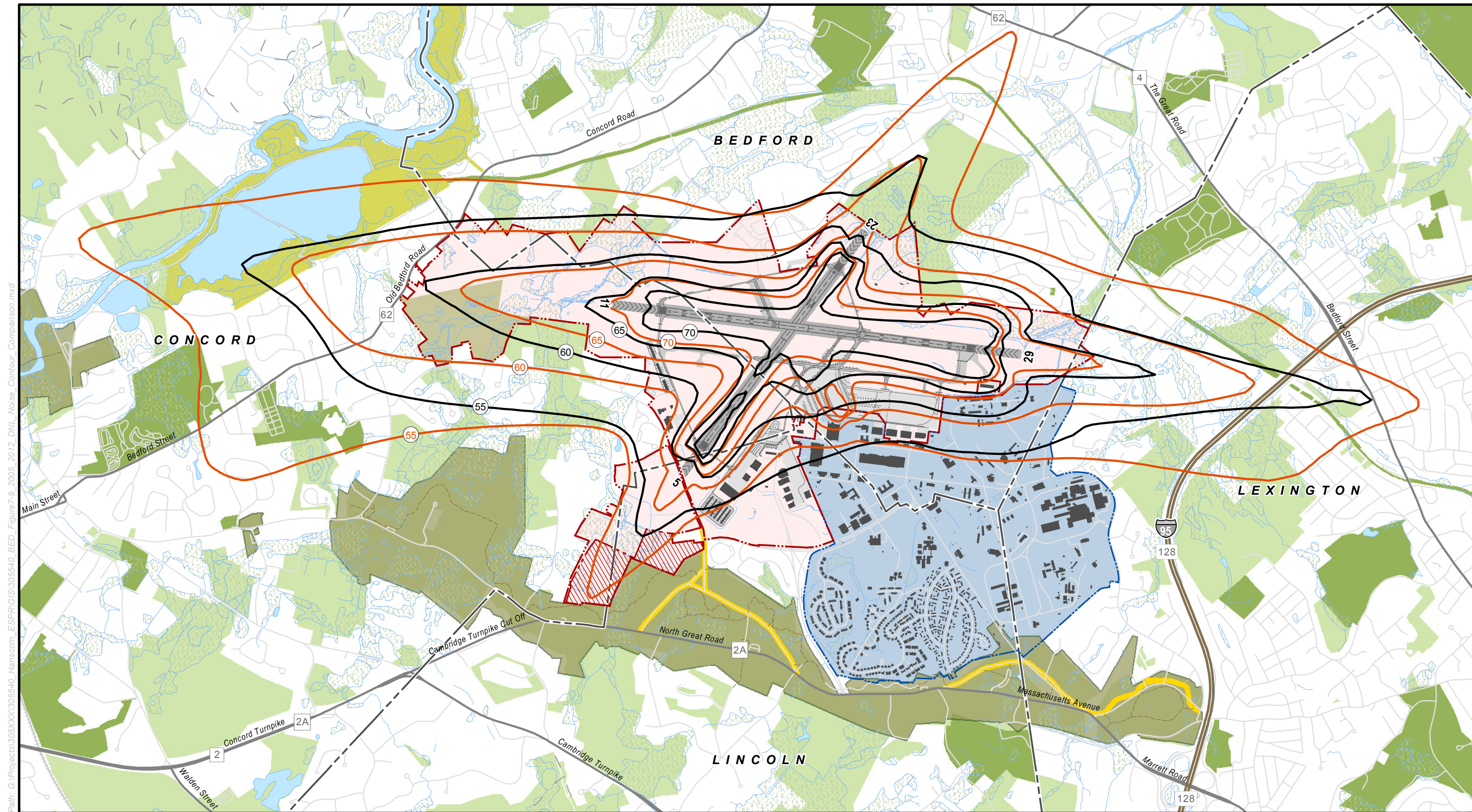
Table 7-9 Area within Year 2012 DNL Contours

DNL Contours (dB)	Cumulative Area ¹		
	2000	2005	2012
70	334 acres	311 acres	181 acres
65	688 acres	635 acres	391 acres
60	1,550 acres	1,437 acres	856 acres
55	3,480 acres	3,291 acres	2,045 acres
Note: 1. Area within contour includes all greater DNL values.			

7.4.1 Comparison of Year 2012 Contours with 2005 Contours

The differences between the Year 2012 contours and the Year 2005 contours are influenced by a number of factors, as discussed below:

- The number of total operations decreased in the past five years. The average number of daily operations dropped from 471 in 2005 to 457 in 2012. Daily jet operations decreased from 92 operations per day in 2005 to 73 in 2012
- The percentage of Stage 2 jets decreased from three percent of civil jet operations in 2005 to less than one percent in 2012.
- The number of daily operations between 10 pm and 7 am decreased by 35 percent from 2005 to 2012.



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- | | | | |
|---|---------------------|------------------------------------|--------|
| 2012 DNL Noise Contour | Historic Road | Open Water | Stream |
| 2005 DNL Noise Contour | Interstate | Wetland/Marsh | |
| Hanscom Field Property Boundary | Highway | | |
| Massport Property within MMNHP Congressional Boundary | Road | MNHP Boundary | |
| Hanscom AFB Property Boundary | Trail | Great Meadows | |
| Municipal Boundary | Active Rail Service | Open Space Non-protected | |
| | | Open Space Protected in Perpetuity | |



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

2005 and 2012 DNL Noise Contour Comparison

Data Sources: MassGIS (Roads, Rail), March 5, 2013; MassGIS (Community Boundaries), March 5, 2013; NPS (Park Boundary), March 8, 2013; ArcGIS - Bing Online (Bing ArcGIS Online, 2011), May 106, 2013

Figure 7-9

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7.4.2 Measured vs. Modeled Noise Levels

Hanscom Field has a system of six permanent noise monitors (see Figure 7-10). Table 7-10 presents the minimum, the mean and the maximum DNL values measured at each of these locations in 2012, as well as the modeled value at each point.

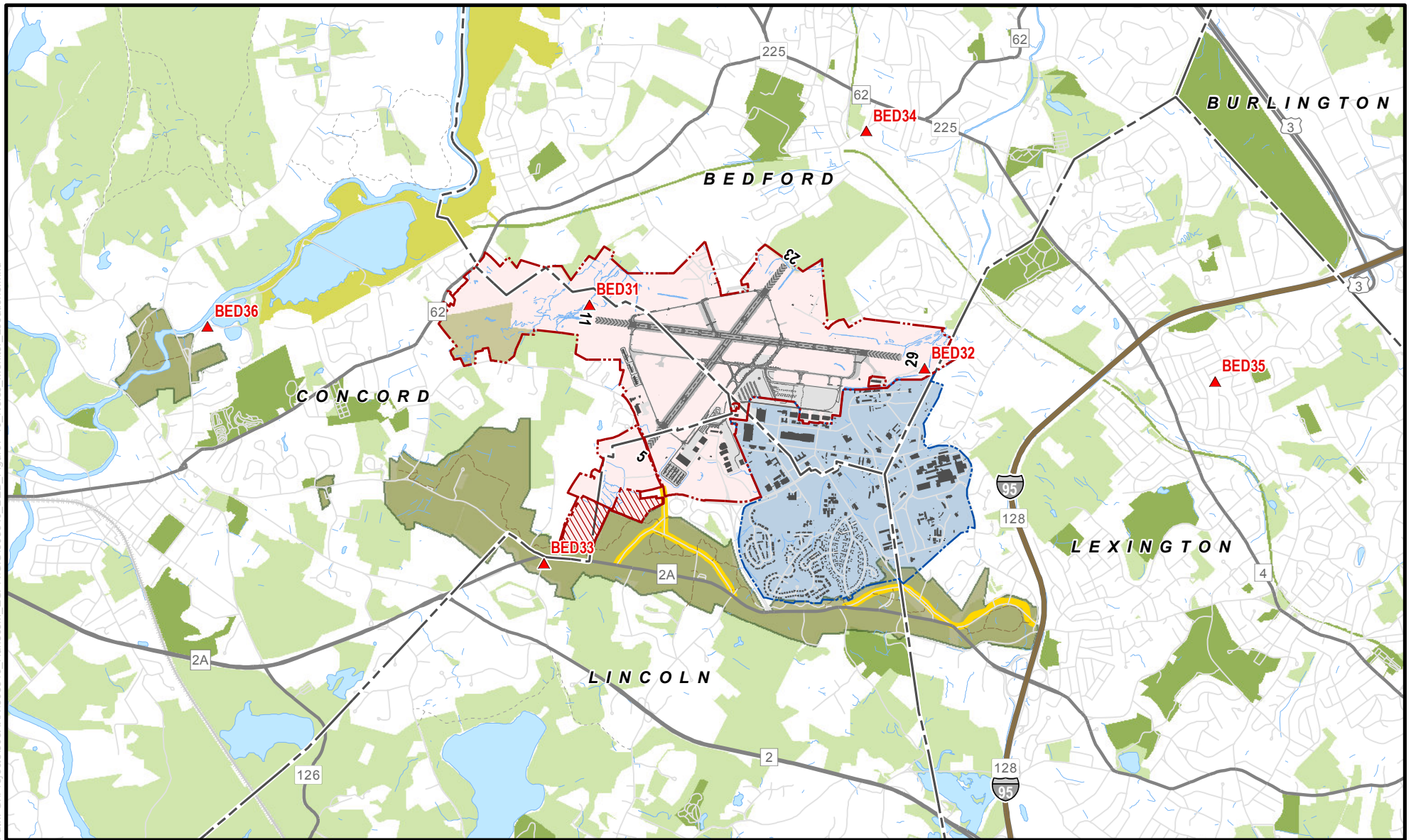
Table 7-10 Measured and Modeled DNL Values (in dB) at Permanent Monitoring Locations

Site Number	Location	Measured Noise (Aircraft and Ambient Sources)			Modeled Aircraft Noise (Aircraft Only)	Measured Minus Modeled
		Minimum	Mean	Maximum		
31	Concord Localizer	54.3	65.1	77.9	63.1	2.0
32	Bedford Localizer	55.8	63.0	73.7	61.0	2.0
33	Lincoln Brooks Road	49.8	55.7	65.1	50.4	5.3
34	Bedford De Angelo Road	54.2	59.2	67.0	50.3	8.9
35	Lexington Preston Road	52.9	60.1	69.9	52.4	7.7
36	Concord Wastewater	58.2	62.0	67.3	49.9	12.1

Source: Massport, HMMH

Table 7-10 shows that the modeled values are in closest agreement with the measured mean values for the sites closest to Hanscom Field, sites 31 and 32. However, the agreement between measured and modeled values decreases as the points get farther from the airfield with the measured values being higher than the corresponding modeled values. This is normal and expected. The reason for these differences is that all noise events are added into the measured DNL regardless of source.

Near the airport, where aircraft noise dominates, agreement with the modeled values is best. Farther from Hanscom Field, where community noise is a significant contributor to the total DNL, agreement is not as good because the measured value includes all noise sources and the modeled value only includes aircraft-related noise. Massport is in the process of working with the community to relocate one of the noise monitors. Massport has already agreed that Site 36 in Concord would be moved. The first noise monitor that was moved was in Bedford and has been relocated. This site has the lowest correlation between measured and modeled noise because of local noise from a wastewater treatment facility. The new location will upgrade the accuracy, usefulness, and reliability of the data.



- ▲ # Noise Monitoring Locations
- Hanscom Field Property Boundary
- Massport Property within MNHP Congressional Boundary
- Hanscom AFB Property Boundary
- Municipal Boundary

- Historic Road
- Interstate
- Highway
- Road
- Trail
- Active Rail Service

- MNHP Boundary
- Great Meadows
- Open Space Non-protected
- Open Space Protected in Perpetuity
- Open Water
- Stream



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Noise Monitoring Locations

Data Sources: MassGIS (Roads, Rail), March 5, 2013; MassGIS (Bike Trails, Tracks and Trails), March 7, 2013; MassGIS (Community Boundaries), March 5, 2013; MassGIS (DEP Wetlands), March 8, 2013; NPS (Park Boundary), March 8, 2013; NPS (Streets and Trails), March 8, 2013; MassGIS (Building Footprints), March 7, 2013

Figure 7-10

7.5 Residential Land Use Impacts

The following sections describe the assessment of land use impacts around Hanscom Field using techniques and criteria based on scientific research, federal law, and FAA recommended guidelines.

7.5.1 Land Use Compatibility Standards

Based on the relationships between noise and the collective response of people to their environment, DNL values have become accepted as a standard for evaluating community noise exposure and as an aid in decision-making regarding the compatibility of alternative land uses by most federal agencies in the U.S. In their application to airport noise in particular, DNL projections have two principle functions:

- To provide a means for comparing existing noise conditions with those that may result from the implementation of noise abatement procedures and/or from forecast changes in airport activity
- To provide a quantitative basis for identifying and judging potential effects of aviation noise on people.

Both of these functions suggest the need for objective criteria. Government agencies dealing with environmental noise have devoted significant attention to this issue, and thus have developed noise/land use compatibility guidelines to help federal, state, and local officials with this evaluation process.

To help address land use planning issues, the FAA has determined that DNL is the official cumulative noise exposure metric for use in airport noise analyses, as prescribed by FAR Part 150. FAR Part 150 includes FAA's recommended guidelines for noise/land use compatibility evaluation, based on a compilation of extensive scientific research into noise-related activity interference and attitudinal response. These guidelines suggest that DNL values of 65 dBA and lower are compatible with residential land use.

7.5.1.1 Research by the U.S. EPA

Pursuant to the Noise Control Act of 1972, the U.S. EPA initiated this effort by publishing scientific data on the effects of noise on people under various levels of exposure. The Agency's preliminary findings were followed in 1974 by a technical report entitled *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, otherwise known as the "Levels Document." This document is still widely cited for its applicability to environmental assessments, and many of its original findings, while refined in more recent years, remain pertinent to understanding how people respond to noise.

EPA is careful to point out that the Levels Document in no way constitutes a regulation or standard. The report, which is the first report to identify a DNL value of 55 dB as a relevant noise level, offers no guidelines for determining land use compatibility. The Levels Document is informational only, and makes no attempt to account for economic or technological feasibility or for peoples' attitudes regarding the desirability of undertaking a project that produces impacts caused by noise. Appendix D discusses additional implications of various DNL levels and their effects on people.

7.5.1.2 Land Use Analysis Methodology

The number of people residing in the DNL contours for 2012 was estimated from existing land use data and 2010 census data obtained from the U.S. Census Bureau. A detailed discussion of this methodology is provided in Appendix D. Table 7-11 presents the population by town exposed to DNL ranges of 65 dB

and above (the FAA's compatibility guideline), and also within lower DNL ranges of 60 to 65 dB, and 55 to 60 dB. The information generated for Year 2012 is compared to past analyses for 2000 and 2005.

Table 7-11 Estimated Population within Hanscom Field 2012 DNL Contours

Town	Total Population between DNL Contours:				
	70 dB or Greater	65 to 70 dB	60 to 65 dB	55 to 60 dB	Total 55 dB or Greater
2000					
Bedford	0	26	270	881	1,177
Concord	0	0	313	839	1,152
Lexington	0	0	0	519	519
Lincoln	0	0	0	0	0
Total	0	26	583	2,239	2,848
2005					
Bedford	0	17	256	872	1,145
Concord	0	0	209	1,075	1,284
Lexington	0	0	0	524	524
Lincoln	0	0	0	0	0
Total	0	17	465	2,471	2,953
2012					
Bedford	0	0	87	369	456
Concord	0	0	0	542	542
Lexington	0	0	0	43	43
Lincoln	0	0	0	0	0
Total	0	0	87	954	1,041

Total population exposed to DNL greater than 65 dB decreased from 26 residents in 2000, 17 residents in 2005, to zero in 2012. The total population in the four towns exposed to DNL values of 55 dB or greater decreased from 2,953 in 2005 (up slightly from 2000) to 1,401 in 2012, reflecting decreases in all four towns, except Lincoln which had no population within the 55 dB DNL contour in 2005.

7.5.2 DNL at Noise Analysis Locations

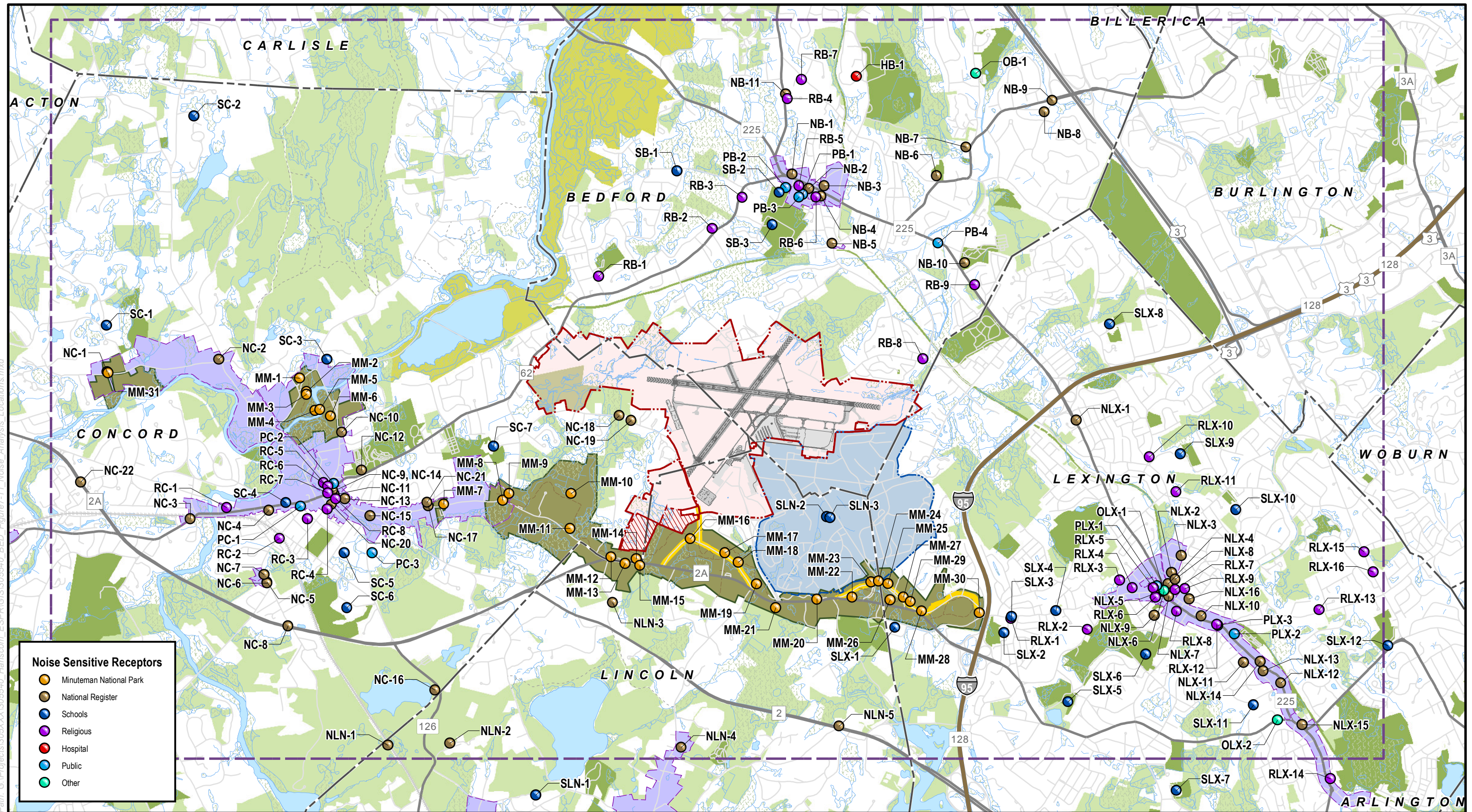
Figure 7-11 shows the locations of noise analysis locations within the vicinity of Hanscom Field. Table 7-12 through 7-15 present the INM-modeled DNL at these locations for 2012 organized by town and includes data previously reported for 2000 and 2005 for comparison. The 2005 *ESPR* labels are provided in these tables for reference purposes.

Information from the 2005 *ESPR* was reviewed and updated to confirm use and address location and identify new facilities. Further input was solicited from the Town Planners and Historic Commissions of Bedford, Concord, Lexington, and Lincoln and the National Park Service. The labeling format of the noise analysis locations indicates their use. Consistent with the 2005 *ESPR*, this format also delineates the location of the site by town.

None of these sites is currently exposed to a DNL value above the FAA land use compatibility criterion of 65 dB and none is within the 60 dB DNL contour. In fact, predicted 2020 and 2030 aircraft noise levels at many of the locations are likely to be below ambient (non-aircraft) levels. One site, the Wheeler-Meriam House in Concord, was modeled at 62.6 dB in 2000 but that has dropped in both 2005 and 2012. It is one of two sites (both in Concord) that have DNL values greater than 55 dB in 2012.

- Deacon John Wheeler/Capt. Jonas Minot Farmhouse in Concord at 58.4 dBA
- Wheeler-Meriam House in Concord at 58.1 dBA

Path: G:\Projects\3055XXX\305540_Hanscom_ESPR\GIS\305540_BED_Figure7-11_Noise_Analysis_Locations.mxd



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Table 7-12 2012 DNL at Noise Analysis Locations in Bedford (in dB)

Label		Name ³	Address/Town	DNL Value		
2012 ¹	2005 ²			2000	2005 ²	2012
HB-1	HB-1	Veterans Administration Medical Center*	200 Springs Rd, Bedford	44.9	43.1	41.8
NB-1	NB-1	Bedford Historic District	Great Rd., Bedford	47.3	44.3	44.6
NB-2	NB-2	Old Bedford Center Historic District	Great Rd., Bedford	47.3	46.0	45.4
NB-3	NB-3	Old Burying Ground	7 Springs Rd., Bedford	-	47.0	45.7
NB-4	NB-4	Old Town Hall	16 South Rd., Bedford	-	47.5	46.1
NB-5	NB-5	Bedford Depot Park Historic District	80 Loomis St./120 South Rd., Bedford	-	53.7	49.8
NB-6	NB-6	Nathaniel Page House	89 Page Rd., Bedford	49.1	50.7	45.9
NB-7	NB-7	Christopher Page House	50 Old Billerica Rd., Bedford	46.8	48.9	44.2
NB-8	NB-8	Bacon-Gleason-Blodgett Homestead	118 Wilson Rd., Bedford	43.7	44.2	41.5
NB-9	NB-9	Historic Wilson Mill-Old Burlington Road Historic Dist.	Old Burlington and Wilson Rds., Bedford	-	44.1	41.3
NB-10	OB-2	Shawsheen Cemetery **	Shawsheen Rd., Bedford	-	46.4	45.2
NB-11	-	David Lane House	137 North Rd., Bedford	-	-	42.1
OB-1	OB-1	Old Billerica Road Area ** (NR nomination form in process)	Old Billerica Rd, Bedford	-	48.0	44.0
PB-1	PB-1	Town Hall *	10 Mudge Way, Bedford	47.3	45.9	45.5
PB-2	PB-2	Library **	7 Mudge Way, Bedford	47.3	44.7	45.0
PB-3	PB-3	Bedford School District	11 Mudge Way, Bedford	47.3	45.9	45.6
PB-4	PB-4	Department of Public Works	314 Great Rd., Bedford	-	47.8	45.4
RB-1	RB-1	The Lutheran Church of the Savior	426 Davis Rd., Bedford	52.0	50.4	48.6
RB-2	RB-2	First Baptist Church of Bedford	155 Concord Rd., Bedford	46.5	44.8	46.0
RB-3	RB-3	St. Michael's Church	90 Concord Rd., Bedford	46.0	43.7	44.9
RB-4	RB-4	Boston Buddha Vararam Temple	125 North Rd., Bedford	-	41.7	42.2
RB-5	RB-5	The First Church of Christ Congregational/ United Church of Christ *	25 Great Rd., Bedford	47.3	45.2	45.1
RB-6	RB-6	The First Parish in Bedford Unitarian Universalist *	75 Great Rd., Bedford	47.3	47.1	46.0
RB-7	RB-7	St. Paul's Episcopal Church	100 Pine Hill Rd., Bedford	44.9	41.6	41.8
RB-8	RB-8	March for Jesus	54 Summer St., Bedford	55.7	54.7	52.2
RB-9	RB-9	Immanuel Baptist Church/ Zion Korean Alliance Church ⁴	400 Great Rd., Bedford	46.9	47.1	45.8
SB-1	SB-1	Davis School	Davis Rd., Bedford	49.0	42.5	43.1
SB-2	SB-2	Bedford High School **	9 Mudge Way, Bedford	47.2	44.6	45.1
SB-3	SB-3	John Glenn Middle School	99 McMahon Rd., Bedford	48.5	45.9	46.7

Notes:

1. The first letter of the label indicates the nature of each site: H for hospital, N for sites in the National Register of Historic Places and/or State Register of Historic Places, O for other, P for public facilities, R for religious sites, S for schools. Other is the category for sites that town representatives specifically requested be added to the noise analysis location list, but do not fit into the other four categories. The second letter indicates the town where the site is located: B for Bedford, C for Concord, LX for Lexington, LN for Lincoln.

2. The labels have been updated for the 2012 ESPR. The 2005 ESPR labels are provided for reference purposes. Blanks indicate new locations that have been added to the 2012 ESPR list of noise analysis locations.

3. Historic districts and cemeteries are evaluated at a central location within the district or cemetery. Sites that are not designated as "N" sites are marked with an asterisk (*) if they are listed in the National Register of Historic Places and two asterisks (**) if they are listed in the State Inventory/MACRIS. Sites are marked with a (†) if they are only listed in the State Register of Historic Places. Sites marked with a (††) contribute to the Old Bedford Center Historic District.

4. The Immanuel Baptist Church and Zion Korean Alliance Church are at the same address.

5. The boundary of the Old Bedford Center Historic District has slightly expanded, the Old Bedford Center Historic District Boundary Extension, since the last study in 2005.

Table 7-13 2012 DNL at Noise Analysis Locations in Concord (in dB)

Label		Name ³	Address/Town	DNL Value		
2012 ¹	2005 ²			2000	2005 ²	2012
NC-1	NC-1	Barrett Farm Historic District†	Barrett's Mill Rd., Concord	49.9	46.6	43.5
NC-2	NC-2	Jonathan Hildreth House	8 Barrett's Mill Rd., Concord	49.9	50.3	47.4
NC-3	NC-3	Joseph Hosmer House	572 Main St., Concord	45.7	45.0	44.3
NC-4	NC-4	Thoreau-Alcott House	255 Main St., Concord	48.6	47.9	46.1
NC-5	NC-5	Hubbardville Historic District†	324-374 Sudbury Rd., Concord	48.6	49.2	46.5
NC-6	NC-6	Hubbard-French Historic District	324-374 Sudbury Rd., Concord	48.6	49.2	46.5
NC-7	NC-7	Deacon Thomas Hubbard/ Judge Henry French House	342 Sudbury Rd., Concord	-	49.0	46.4
NC-8	NC-8	Pest House	158 Fairhaven Rd., Concord	48.3	49.9	46.3
NC-9	NC-9	Main Street Historic District†	Main St. between Monument Sq. and Wood St., Concord	48.8	50.8	48.0
NC-10	NC-10	North Bridge-Monument Square Historic District†	Monument St., Liberty St. and Lowell St., Concord	50.6	50.5	48.2
NC-11	NC-11	Wright Tavern	Lexington Rd. & Main St., Concord	50.9	51.0	48.2
NC-12	NC-12	Sleepy Hollow Cemetery	24 Court Ln., Concord	-	52.2	49.0
NC-13	NC-13	American Mile Historic District†	Lexington Rd., Concord	50.9	51.7	48.5
NC-14	NC-14	Concord Monument Square-Lexington Road Historic District	Monument Sq. and Lexington Rd., Concord	50.9	50.9	48.1
NC-15	NC-15	Ralph Waldo Emerson House	28 Cambridge Turnpike, Concord	51.3	52.9	49.1
NC-16	NC-16	Walden Pond ⁴	MA Rte 126 (Main Beach), Concord	45.1	45.8	43.4
NC-17	NC-17	Orchard House	399 Lexington Rd., Concord	52.6	53.8	50.2
NC-18	NC-18	Deacon John Wheeler/ Capt. Jonas Minot Farmhouse	341 Virginia Rd., Concord	-	60.4	58.4
NC-19	NC-19	Wheeler-Meriam House	477 Virginia Rd., Concord	62.6	59.9	58.1
NC-20	-	Concord Armory-Concord Veteran's Building	51 Walden St., Concord	-	-	48.1
NC-21	-	Concord School of Philosophy	391 Lexington Rd., Concord	-	-	50.3
NC-22	-	Hosmer Homestead	138 Baker Ave., Concord	-	-	41.6
PC-1	PC-1	Library **	129 Main St., Concord	49.6	49.4	47.1
PC-2	PC-2	Town Hall ††	22 Monument Sq., Concord	50.9	50.8	48.1
PC-3	PC-3	Middlesex County Court House	305 Walden St., Concord	49.9	52.4	48.4
RC-1	RC-1	Trinity Episcopal Church **	81 Elm St., Concord	47.4	46.0	45.0
RC-2	RC-2	Redeemer Presbyterian Church	191 Sudbury Rd., Concord	49.1	49.0	46.7
RC-3	RC-3	New Life Community Church (meeting at the Emerson School Building **)	40 Stow St., Concord	50.9	50.0	47.4
RC-4	RC-4	Trinitarian Congregational Church **	54 Walden St., Concord	50.9	50.9	48.0
RC-5	RC-5	First Church of Christ Scientist††	7 Lowell Rd., Concord	50.9	50.2	47.7
RC-6	RC-6	St. Bernard's Parish††	70 Monument Square, Concord	50.9	50.5	47.9
RC-7	RC-7	Christian Science Reading Room	20 Main St., Concord	49.0	50.7	47.9
RC-8	RC-8	First Parish in Concord ††	20 Lexington Rd., Concord	50.9	51.2	48.2
SC-1	SC-1	Nashoba/Brooks School	200 Strawberry Hill Rd., Concord	45.0	49.3	46.5
SC-2	SC-2	Middlesex School**	1400 Lowell Rd., Concord	46.8	41.3	40.4
SC-3	SC-3	Fenn School **	498-516 Monument St., Concord	54.1	53.7	50.9
SC-4	SC-4	Concord Academy **	166 Main St., Concord	49.6	48.6	46.6
SC-5	SC-5	Alcott School	91 Laurel Rd., Concord	50.1	51.8	48.1
SC-6	SC-6	Concord/Carlisle High School	500 Walden Rd., Concord	48.5	50.8	46.8
SC-7	SC-7	Ripley School	120 Meriam Rd., Concord	55.7	56.4	53.6

Notes:

1. The first letter of the label indicates the nature of each site: H for hospital, N for sites in the National Register of Historic Places and/or State Register of Historic Places, O for other, P for public facilities, R for religious sites, S for schools. Other is the category for sites that town representatives specifically requested be added to the noise analysis location list, but do not fit into the other four categories. The second letter indicates the town where the site is located: B for Bedford, C for Concord, LX for Lexington, LN for Lincoln.

2. The labels have been updated for the 2012ESPR. The 2005 ESPR labels are provided for reference purposes. Blanks indicate new locations that have been added to the 2012 ESPR list of noise analysis locations. The Old Manse and the Wayside (Samuel Whitney House) are included in the Minute Man National Historical Park list of noise analysis locations.

Label		Name ³	Address/Town	DNL Value		
2012 ¹	2005 ²			2000	2005 ²	2012
3. Historic districts and cemeteries are evaluated at a central location within the district or cemetery. Sites that are not designated as "N" sites are marked with an asterisk (*) if they are listed in the National Register of Historic Places and two asterisks (**) if they are listed in the State Inventory/MACRIS. Sites are marked with a (†) if they are only listed in the State Register of Historic Places. Sites marked with a (††) contribute to the Concord Monument Square-Lexington Road Historic District.						
4. The Walden Pond State Reservation is located in Concord and Lincoln. This site is located at the main beach in Concord.						

Table 7-14 2012 DNL at Noise Analysis Locations in Lexington (in dB)

Label		Name ³	Address/Town	DNL Value		
2012 ¹	2005 ²			2000	2005 ²	2012
NLX-1	NLX-1	Simonds Tavern	331 Bedford St., Lexington	55.7	55.5	53.0
NLX-2	NLX-2	Hancock-Clarke Historic District†	Hancock St., Lexington	43.5	47.0	42.8
NLX-3	NLX-3	Hancock-Clarke House	35 Hancock St., Lexington	43.5	46.6	42.6
NLX-4	NLX-4	Garrity House	9 Hancock St., Lexington	-	47.1	42.7
NLX-5	NLX-5	Lexington Green Historic District	Mass. Ave., Harrington Rd. and Bedford St., Lexington	44.5	47.4	42.9
NLX-6	NLX-6	Lexington Green	Mass. Ave., Harrington Rd. and Bedford St., Lexington	44.5	47.2	42.7
NLX-7	NLX-7	Buckman Tavern	1 Bedford St., Lexington	44.5	46.9	42.5
NLX-8	NLX-8	General Samuel Chandler House	8 Goodwin Rd., Lexington	44.5	46.8	42.5
NLX-9	NLX-9	Hancock School	33 Forest St., Lexington	44.1	47.3	42.6
NLX-10	NLX-10	U.S. Post Office Building	1661 Mass. Ave., Lexington	41.0	44.9	40.8
NLX-11	NLX-11	Warren E. Shelburne House	11 Percy Rd., Lexington	37.4	42.0	38.4
NLX-12	NLX-12	Munroe Tavern Historic District†	Mass. Ave., Lexington	35.4	39.5	36.6
NLX-13	NLX-13	Sanderson House-Munroe Tavern	1314 & 1332 Mass. Ave., Lexington	35.4	40.7	37.4
NLX-14	NLX-14	John Mason House	1303 Mass. Ave., Lexington	35.4	41.0	37.7
NLX-15	NLX-15	East Village Historical District†	Mass Ave., Lexington	32.6	37.7	35.3
NLX-16	-	M.H. Merriam and Company	7-9 Oakland Ave., Lexington	-	-	41.6
OLX-1	OLX-1	Battle Green Historic District**	Worthen Rd., Woburn St., Hastings Rd., Mass. Ave. and B&M Railroad, Lexington	44.5	47.2	42.8
OLX-2	OLX-2	National Heritage Museum	33 Marrett Rd., Lexington	-	39.2	36.2
PLX-1	PLX-1	Library **	1874 Mass. Ave., Lexington	44.5	47.7	43.1
PLX-2	PLX-2	Town Hall **	1625 Mass. Ave., Lexington	38.1	42.9	39.3
PLX-3	PLX-3	Lexington School District Administration **	1557 Massachusetts Ave., Lexington	40.0	43.9	40.0
RLX-1	RLX-1	Lexington United Methodist Church/ St. John's Korean United Methodist Church ⁴	2600 Massachusetts Ave., Lexington	46.9	48.1	45.9
RLX-2	RLX-2	Temple Isaiah	55 Lincoln St., Lexington	46.6	48.5	44.2
RLX-3	RLX-3	Grace Chapel of Lexington	59 Worthen Rd., Lexington	46.2	49.3	44.6
RLX-4	RLX-4	St. Brigid's Parish *	2001 Mass. Ave., Lexington	44.5	48.7	44.0
RLX-5	RLX-5	First Parish-Unitarian Church††	7 Harrington Rd., Lexington	44.5	47.8	43.2
RLX-6	RLX-6	Hancock United Church of Christ ††	1912 Mass. Ave., Lexington	44.5	47.5	43.0
RLX-7	RLX-7	Church of Our Redeemer	6 Meriam St., Lexington	44.5	46.7	42.3
RLX-8	RLX-8	Christian Science Reading Room	10 Muzzy St. #12, Lexington	42.8	46.3	41.8
RLX-9	RLX-9	Greek Orthodox Church of St. Nichols **	17 Meriam St., Lexington	44.5	46.1	42.0
RLX-10	RLX-10	Chabad Center **	9 Burlington St., Lexington	-	52.0	49.9
RLX-11	RLX-11	Pilgrim Congregational Church	55 Coolidge Ave., Lexington	46.3	48.0	44.9
RLX-12	RLX-12	First Baptist Church of Lexington **	1580 Mass. Ave., Lexington	38.1	44.0	40.1
RLX-13	RLX-13	Jehovah's Witnesses	196 Woburn St., Lexington	35.1	38.1	36.7
RLX-14	RLX-14	Follen Church Society- Unitarian Universalists *	755 Massachusetts Ave., Lexington	-	35.6	34.0
RLX-15	RLX-15	Countryside Bible Chapel	480 Lowell St., Lexington	37.3	39.2	37.3
RLX-16	RLX-16	St. Paul Evangelical Church	451 Lowell St., Lexington	36.2	37.4	36.2
SLX-1	SLX-1	Minuteman Regional Vocational High	758 Marrett Rd., Lexington	43.9	45.9	44.8

Label		Name ³	Address/Town	DNL Value		
2012 ¹	2005 ²			2000	2005 ²	2012
		School				
SLX-2	SLX-2	Maria Hastings School	2618 Mass. Ave., Lexington	46.9	47.8	45.4
SLX-3	SLX-3	Methodist Weekday School	2600 Massachusetts Ave., Lexington	46.9	48.1	46.0
SLX-4	SLX-4	Community Nursery School	2325 Massachusetts Ave., Lexington	47.3	48.9	45.8
SLX-5	SLX-5	Bridge Elementary School**	55 Middleby Rd., Lexington	45.1	47.1	42.2
SLX-6	SLX-6	Lexington High School	251 Waltham St., Lexington	43.8	46.7	41.7
SLX-7	SLX-7	Jonas Clarke Middle School	17 Stedman Rd., Lexington	40.3	43.5	37.6
SLX-8	SLX-8	Estabrook School**	117 Grove St., Lexington	49.9	48.6	44.5
SLX-9	SLX-9	Diamond Middle School	99 Hancock St., Lexington	51.3	51.5	50.1
SLX-10	SLX-10	Fiske Elementary School	146 Maple St., Lexington	42.9	44.8	42.4
SLX-11	SLX-11	Armenian Sisters Academy	20 Pelham Rd., Lexington	35.8	40.7	37.2
SLX-12	SLX-12	Harrington Elementary School	148 Maple St., Lexington	31.9	34.4	33.5

Notes:

1. The first letter of the label indicates the nature of each site: H for hospital, N for sites in the National Register of Historic Places and/or State Register of Historic Places, O for other, P for public facilities, R for religious sites, S for schools. Other is the category for sites that town representatives specifically requested be added to the noise analysis location list, but do not fit into the other four categories, or historic districts that are not on the National Register of Historic Places. The second letter indicates the town where the site is located: B for Bedford, C for Concord, LX for Lexington, LN for Lincoln.
2. The labels have been updated for the 2012 ESPR. The 2005 ESPR labels are provided for reference purposes. Blanks indicate new locations that have been added to the 2012 ESPR list of noise analysis locations.
3. Historic districts and cemeteries are evaluated at a central location within the district or cemetery. Sites that are not designated as "N" sites are marked with an asterisk (*) if they are listed in the National Register of Historic Places and two asterisks (**) if they are listed in the State Inventory/MACRIS. Sites are marked with a (†) if they are only listed in the State Register of Historic Places. Sites marked with a (††) contribute to the Lexington Green Historic District.
4. The Lexington United Methodist Church and St. John's Korean United Methodist Church are at the same address.

Table 7-15 2012 DNL at Noise Analysis Locations in Lincoln (in dB)

Label		Name ³	Address/Town	DNL Value		
2012 ¹	2005 ²			2000	2005 ²	2012
NLN-1	NLN-1	Walden Pond ⁴	Rte. 126, Walden St., Concord Rd., Lincoln	-	45.9	42.6
NLN-2	NLN-2	Henry Higginson House	44 Baker Farm Rd., Lincoln	-	45.1	42.5
NLN-3	NLN-3	Daniel Brooks House	Brooks Rd., Lincoln	51.0	49.5	48.4
NLN-4	NLN-4	Lincoln Center Historic District	Bedford Rd. Lincoln Rd., Old Lexington Rd. Sandy Pond Rd. Trapelo Rd. Weston Rd., Lincoln	40.4	41.0	41.0
NLN-5	NLN-5	Hoar Tavern	268 Cambridge Tpke., Lincoln	41.9	43.0	41.8
SLN-1	SLN-1	Carroll School	25 Baker Bridge Rd., Lincoln	49.3	41.7	40.8
SLN-2	SLN-2	Hanscom Middle School	Hanscom AFB, Lincoln	50.1	49.1	50.2

Notes:

1. The first letter of the label indicates the nature of each site: H for hospital, N for sites in the National Register of Historic Places and/or State Register of Historic Places, O for other, P for public facilities, R for religious sites, S for schools. Other is the category for sites that town representatives specifically requested be added to the noise analysis location list, but do not fit into the other four categories. The second letter indicates the town where the site is located: B for Bedford, C for Concord, LX for Lexington, LN for Lincoln.
2. The labels have been updated for the 2012 ESPR. The 2005 ESPR labels are provided for reference purposes. Blanks indicate new locations that have been added to the 2012 ESPR list of noise analysis locations.
3. Historic districts and cemeteries are evaluated at a central location within the district or cemetery. Sites that are not designated as "N" sites are marked with an asterisk (*) if they are listed in the National Register of Historic Places and two asterisks (**) if they are listed in the State Inventory/MACRIS.
4. The Walden Pond State Reservation is located in Concord and Lincoln. This site is in Heywood's Meadow.

The DNL generally decreased between 2005 and 2012 for the noise analysis locations common to the 2005 ESPR and the 2012 ESPR. The average decrease in DNL across all sites was 2.5 dBA, with sites in Bedford recording an average of decrease of 1.2 dBA, minus 2.7 dBA in Concord, minus 3.5 dBA in Lexington, and minus 0.9 in Lincoln.

The largest individual DNL increases were an increase of 1.2 dBA from 44.8 dBA to 46.0 dBA at the First Baptist Church of Bedford (RB-2) and an increase of 1.2 dBA from 43.7 dBA to 44.9 dBA at St. Michael's Church (RB-3), both on Concord Rd in Bedford. The largest individual DNL decreases were a decrease of 5.9 dBA from 43.5 dBA to 37.6 dBA at the Jonas Clarke Middle School (SLX-7) in Lexington and a decrease of 5.0 dBA from 46.7 dBA to 41.7 dBA at the Lexington High School (SLX-6). Areas with lower noise levels are more susceptible to larger changes due to normal shifts in runway and flight corridor utilization.

The largest changes for sites with a 2005 or 2012 *ESPR* DNL of 50 dBA or more was a decrease of 4.8 dBA from 50.7 dBA to 45.9 dBA at the Nathaniel Page House (NB-6) in Bedford and an increase of 1.1 dBA from 49.1 dBA to 50.2 dBA at the Hanscom Middle School (SLN-2) on the Hanscom AFB in Lincoln.

7.5.3 Time Above

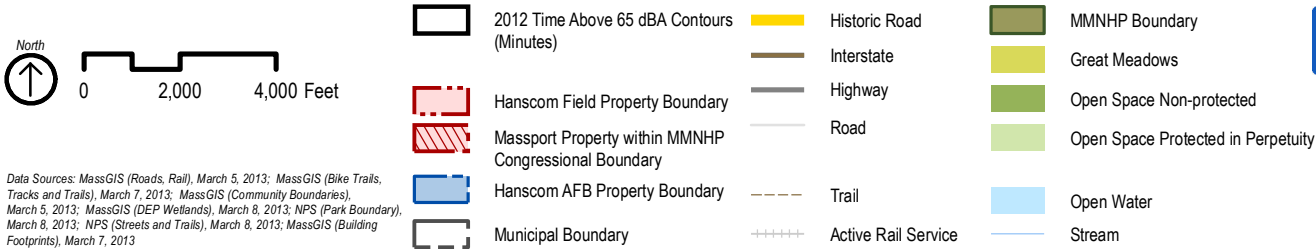
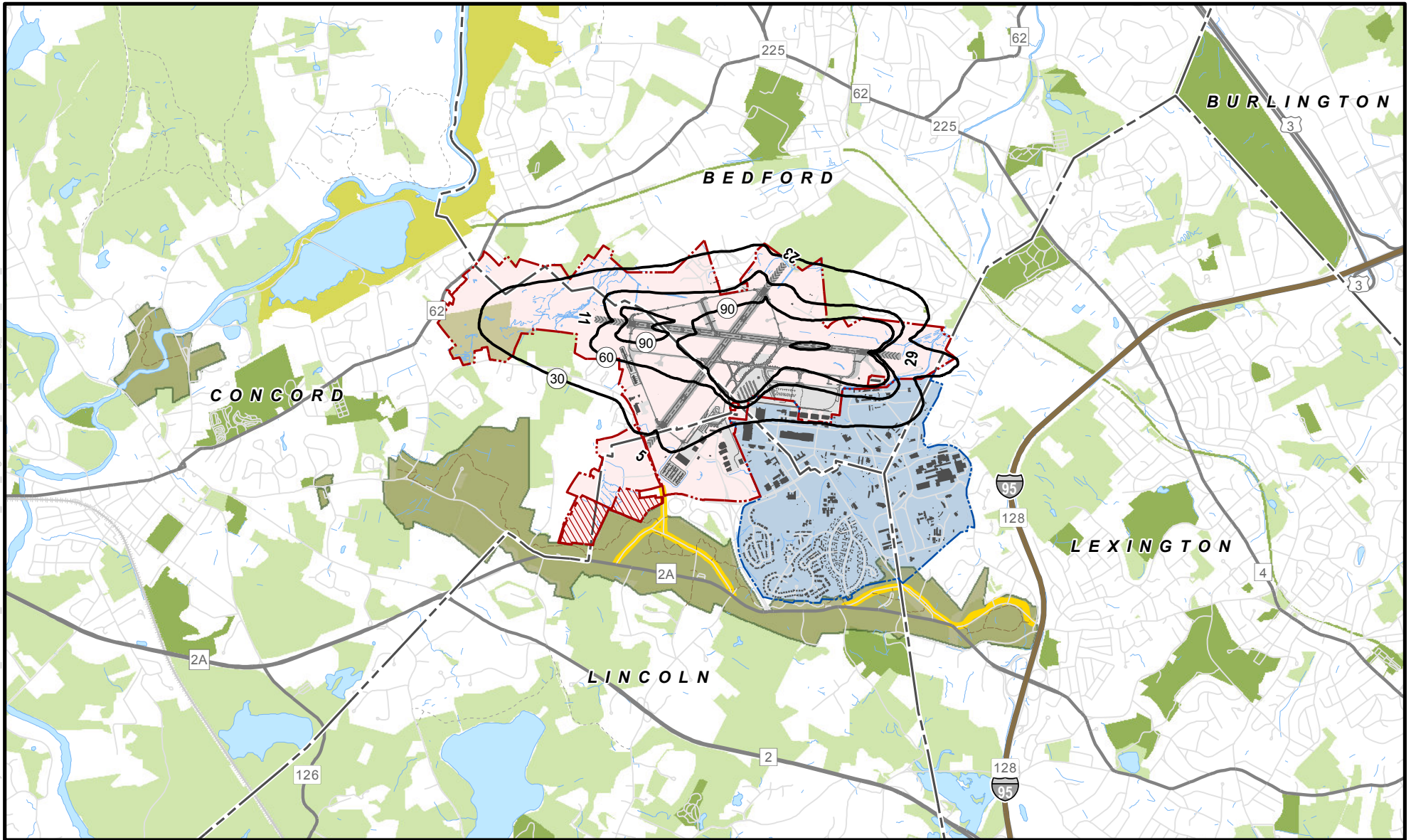
A Time Above threshold level of 65 dBA is considered useful by acousticians when considering speech interference. People can generally carry on acceptable outdoor conversations in a normal voice at typical communication distances of three to four feet as long as the background noise (in this case, aircraft) remains less than 65 dBA. Also, in a house with open windows, a 65 dBA sound level outdoors produces an indoor sound level that is low enough to permit relaxed conversation at communication distances up to about six feet.

In the 2012 *ESPR*, like the 2000 and 2005 *ESPRs*, Massport has also provided information on times above a lower threshold of 55 dBA. Outdoor conversations at a normal voice effort in the presence of these lower levels are typically acceptable to distances of ten to 15 feet, and indoors with windows open conversations would be acceptable using a normal voice effort at distances of 15 feet or more (see Appendix D).

The 2012 *ESPR* reports the results in the form of contours showing areas where aircraft noise exceeds the two threshold sound levels of 65 and 55 dBA for periods of 30, 60, and 90 minutes per day.³³ Figure 7-12 presents TA 65 dBA contours and Figure 7-13 presents the TA 55 dBA contours. The cumulative areas within the TA contours for 2000, 2005 and 2012 are presented in Table 7-16. The data is divided between Massport property, Hanscom AFB, and off property (meaning outside Hanscom Field and Hanscom AFB). The sizes of the TA 55 dBA and TA 65 dBA contours generally decreased in 2012 relative to 2005 for the 30 minute contours and increased for the 60 minute and 90 minute contours.

³³Note that nighttime noise sources are not assessed an additional penalty in the Time Above metric.

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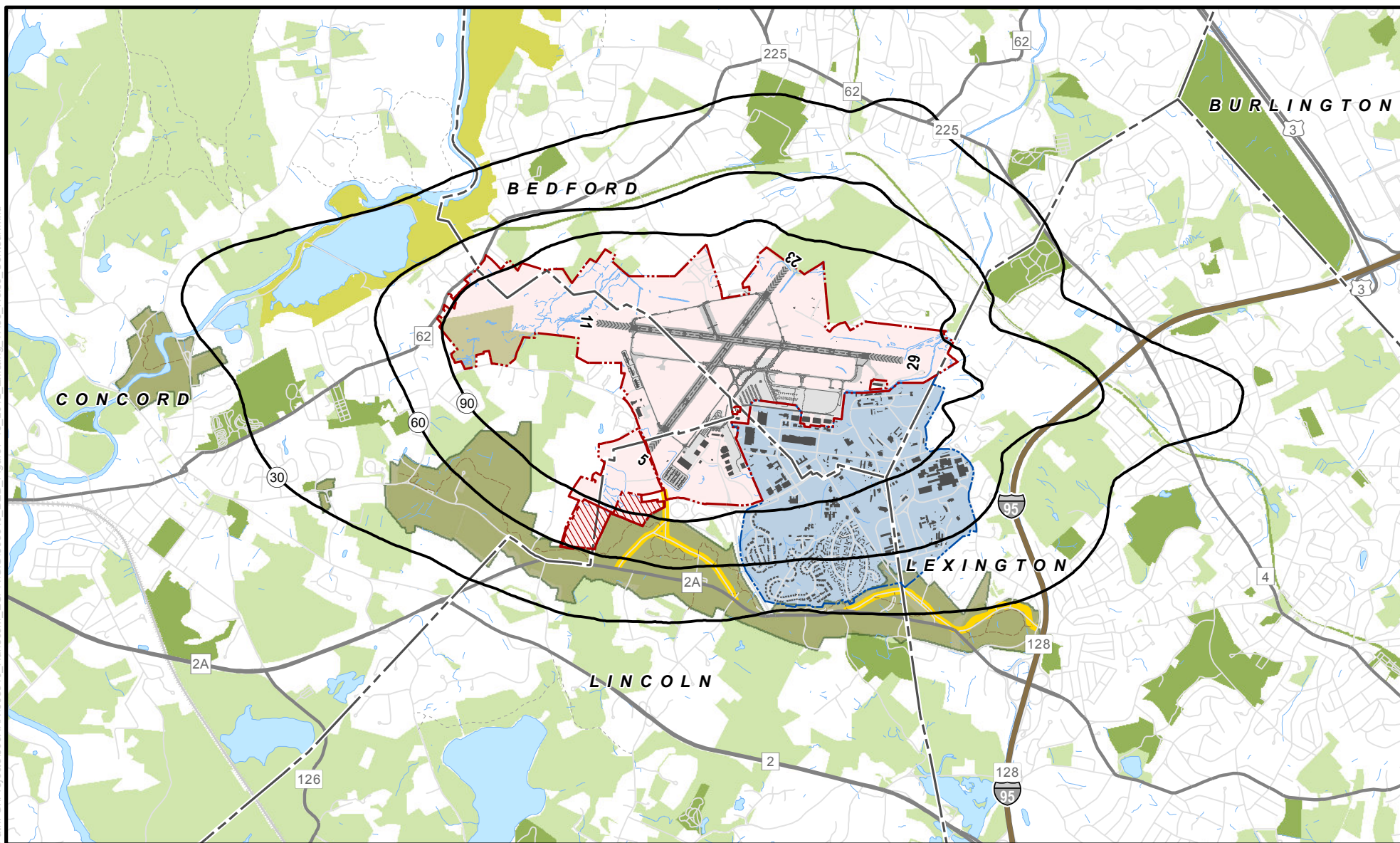
Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

2012 Time Above 65 dBA Contours

Figure 7-12

Data Sources: MassGIS (Roads, Rail), March 5, 2013; MassGIS (Bike Trails, Tracks and Trails), March 7, 2013; MassGIS (Community Boundaries), March 5, 2013; MassGIS (DEP Wetlands), March 8, 2013; NPS (Park Boundary), March 8, 2013; NPS (Streets and Trails), March 8, 2013; MassGIS (Building Footprints), March 7, 2013

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- | | | |
|---|---------------------|------------------------------------|
| 2012 Time Above 55 dBA Contours (Minutes) | Historic Road | MMNHP Boundary |
| Hanscom Field Property Boundary | Interstate | Great Meadows |
| Massport Property within MMNHP Congressional Boundary | Highway | Open Space Non-protected |
| Hanscom AFB Property Boundary | Road | Open Space Protected in Perpetuity |
| Municipal Boundary | Trail | Open Water |
| | Active Rail Service | Stream |



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

2012 Time Above 55 dBA Contours

Data Sources: MassGIS (Roads, Rail), March 5, 2013; MassGIS (Bike Trails, Tracks and Trails), March 7, 2013; MassGIS (Community Boundaries), March 5, 2013; MassGIS (DEP Wetlands), March 8, 2013; NPS (Park Boundary), March 8, 2013; NPS (Streets and Trails), March 8, 2013; MassGIS (Building Footprints), March 7, 2013

Figure 7-13

Table 7-16 2012 Area within Time Above 65 and 55 dBA Contours

Time Above Contour Level	Cumulative Area (Acres)											
	2000	2000 Massport	2000 AFB	2000 Off Airport	2005	2005 Massport	2005 AFB	2005 Off Airport	2012	2012 Massport	2012 AFB	2012 Off Airport
TA 65 dBA Contour												
90 minutes	169	158	11	0	281	279	0	2	289	275	0	14
60 minutes	468	436	22	10	498	468	8	22	526	489	12	25
30 minutes	1,120	883	75	162	1,326	956	78	292	1,238	933	89	216
TA 55 dBA Contour												
90 minutes	1,619	1,073	139	407	1,828	1,060	166	602	2,362	1,247	336	779
60 minutes	3,171	1,299	468	1,404	3,551	1,254	447	1,850	4,006	1,301	640	2,065
30 minutes	6,798	1,302	744	4,752	8,405	1,302	761	6,342	7,542	1,302	782	5,458

Table 7-17 presents the population between the contour levels for the TA 65 and 55 dBA metrics for 2005 and 2012. Appendix D describes the methodology used to compute these population counts based on the contour geometry, US Census data, and land use polygons.

Table 7-17 2012 Population within Time Above 65 and 55 dBA Contours

Time Above Contour Level	Population between Contours		
	2000	2005	2012
TA 65 dBA Contour			
90 minutes or greater	0	0	0
60 to 90 minutes	1	50	52
30 to 60 minutes	353	470	349
Total 30 Minutes or Greater	354	520	401
TA 55 dBA Contour			
90 minutes	641	937	1,139
60 minutes	1,234	1,301	2,610
30 minutes	7,107	9,112	6,234
Total 30 Minutes or Greater	8,982	11,350	9,983

7.5.4 Total Noise Exposure (EXP)

Table 7-18 presents the EXP for 2012 at Hanscom Field. Appendix D presents detailed results of the 2012 EXP calculation. The total EXP for civil departures was 107.4 dB using INM Version 7.0c presents a historic comparison of EXP values from 1987 to 2012 using increasingly updated versions of the INM as discussed earlier in this chapter.

Table 7-18 Year 2012 Total Noise Exposure (EXP) (in dB)

Groups	Departure Only	Arrival Only	Total
All civil aircraft except single piston	106.2	106.6	109.5
All civil aircraft	107.4	108.0	110.7
All military aircraft	91.3	87.8	92.9
All civil and military aircraft except single piston	106.3	106.6	109.5
All civil and military aircraft	107.5	108.0	110.8

Table 7-19 Historic Trends in EXP

Year	Civilian Aircraft Departure EXP	Noise Model
1987	112.0	INM Version 3.9
1988	112.4	
1989	111.6	
1990	110.8	
1991	110.7	
1992	111.4	
1993	110.6	
1994	111.4	
1995	111.6	
1996	112.0	INM Version 5.1
1997	112.3	
1998	113.1	
1999	113.0	
2000	112.3	INM Version 6.0c
2001	111.6	
2002	112.4	
2003	111.9	
2004	111.9	
2005	111.4	INM Version 6.1
2006	111.0	
2007	111.3	
2008	110.2	
2009	109.2	
2010	109.2	
2011	109.1	
2012	107.4	INM Version 7.0c

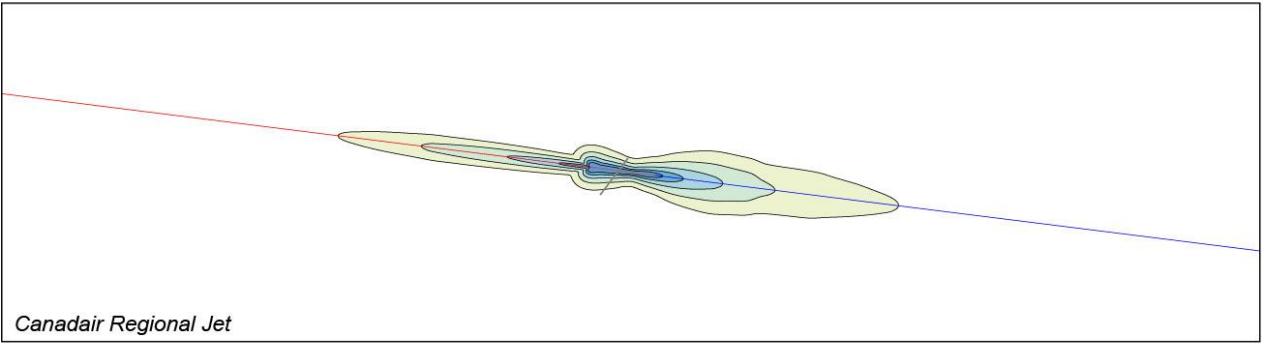
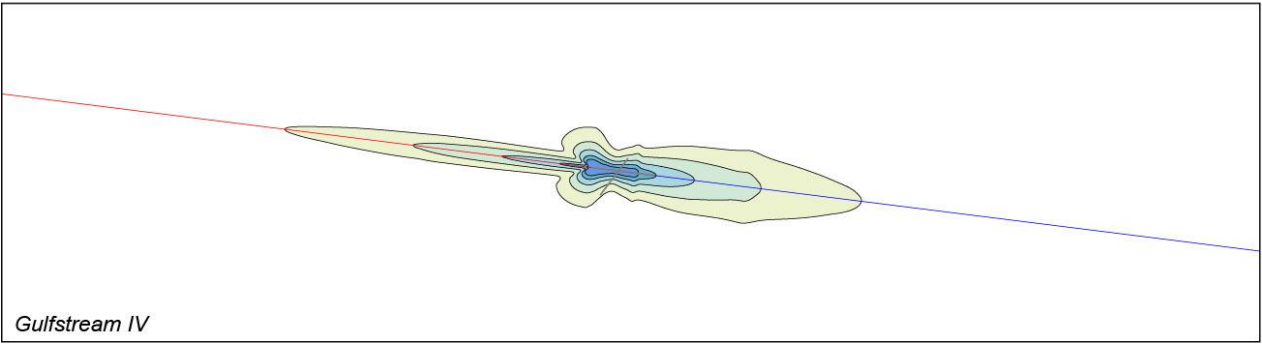
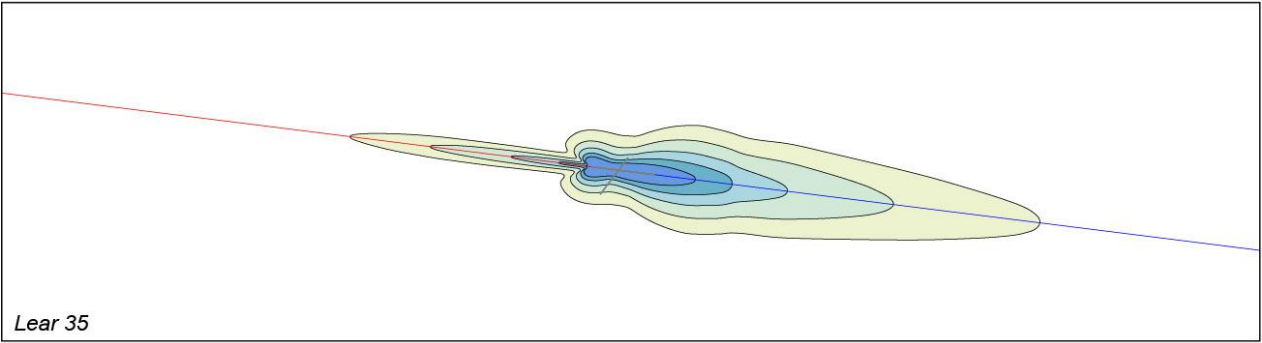
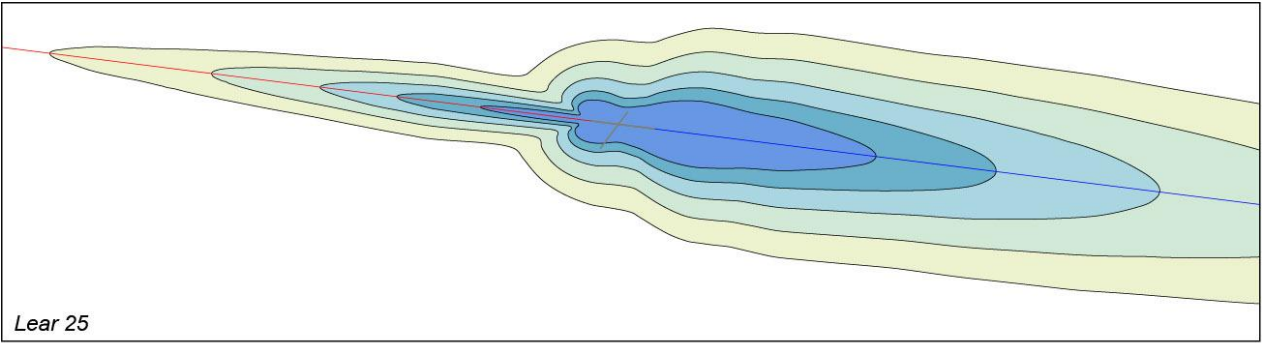
Source: Massport

7.5.5 SEL Contours

Figure 7-14 and Figure 7-15 depict contours for comparison of single-event noise levels for some common aircraft types at Hanscom Field. Figure 7-14 presents SEL contours for departure and arrival of four typical general aviation jets: the Lear 25, the Lear 35, the Gulfstream IV, and the Canadair Regional Jet. The Lear 25 is a typical Stage 2 Corporate Jet, whereas the Lear 35 (the most common jet operating at Hanscom Field), the Gulfstream IV, and the Canadair Regional Jet are Stage 3 Corporate Jets.³⁴ The Canadair Regional Jet is a modified business jet that is often used in commuter operations.

Figure 7-14 shows that at any given location, SELs for Stage 2 aircraft are typically 10 to 15 dB higher than the Stage 3 aircraft. Keeping in mind the logarithmic nature of decibels, a single operation by one of the Stage 2 jets will have 10 times the influence on the total noise level (DNL or EXP) as a Stage 3 jet. Figure 7-15 shows the departure single-event noise contours for the most common propeller aircraft at

³⁴As a result of the Airport Noise and Capacity Act of 1990, the only Stage 2 jets that are allowed to fly in the U.S. since December 1999 are those weighing less than 75,000 pounds. This includes most general aviation jets. In 2012, Congress passed the FAA Modernization and Reform Act, which included the phase out of all non-stage 3 aircraft by December 31, 2015.



North

Scale in Statute Miles (1 mi = 5,280 ft)



SEL 95

SEL 90

SEL 85

SEL 80

SEL 75

Figure 7-14 SEL Contours for Common General Aviation Jet Aircraft

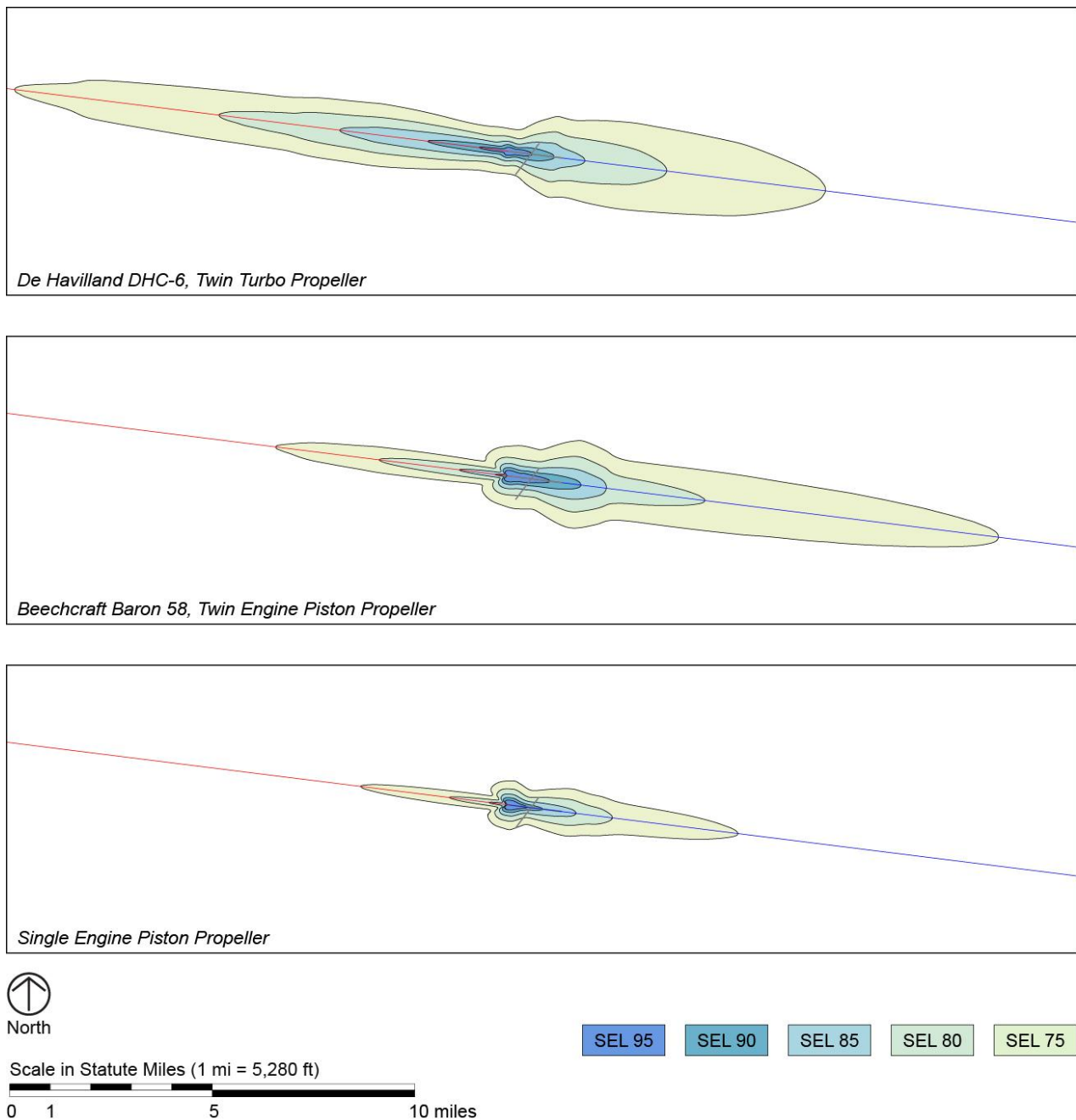


Figure 7-15 SEL Contours for Common Propeller Aircraft

Hanscom Field: a de Havilland DHC-6 twin turbo propeller, a Beechcraft Baron 58 twin-engine piston propeller, and a single engine piston propeller.

A recommendation of the Hanscom Noise Workgroup was to evaluate the distribution of "noise events" at Hanscom Field. For this purpose, the INM-computed SEL for each aircraft departing the airport (the same metric used in the computation of EXP) was grouped into a 5-decibel increment with all other aircraft producing similar noise levels, and the number of daily occurrences was tallied for each future scenario in the 2012 *ESPR*.

Figure 7-16 presents a plot of the distribution of the SEL values for historical data: 1987, 1990, 1995, 2000, 2005, and 2012. Data were derived from Massport's Annual Noise Reports for 1987 and 1990, the 1995 GEIR for 1995, and the *ESPRs* for 2000 and 2005. Single engine piston propeller aircraft were

excluded from the presentation so that differences between the numbers of operations by louder aircraft for the various scenarios would be clear. Inclusion of these departures (172 per day in 2012) would have compressed the y-axis to the point that these differences would have been unreadable. The figure shows that operations by the noisiest aircraft types (SEL greater than 95 dBA) decreased over time, while operations by relatively quieter aircraft types increased during that same period.

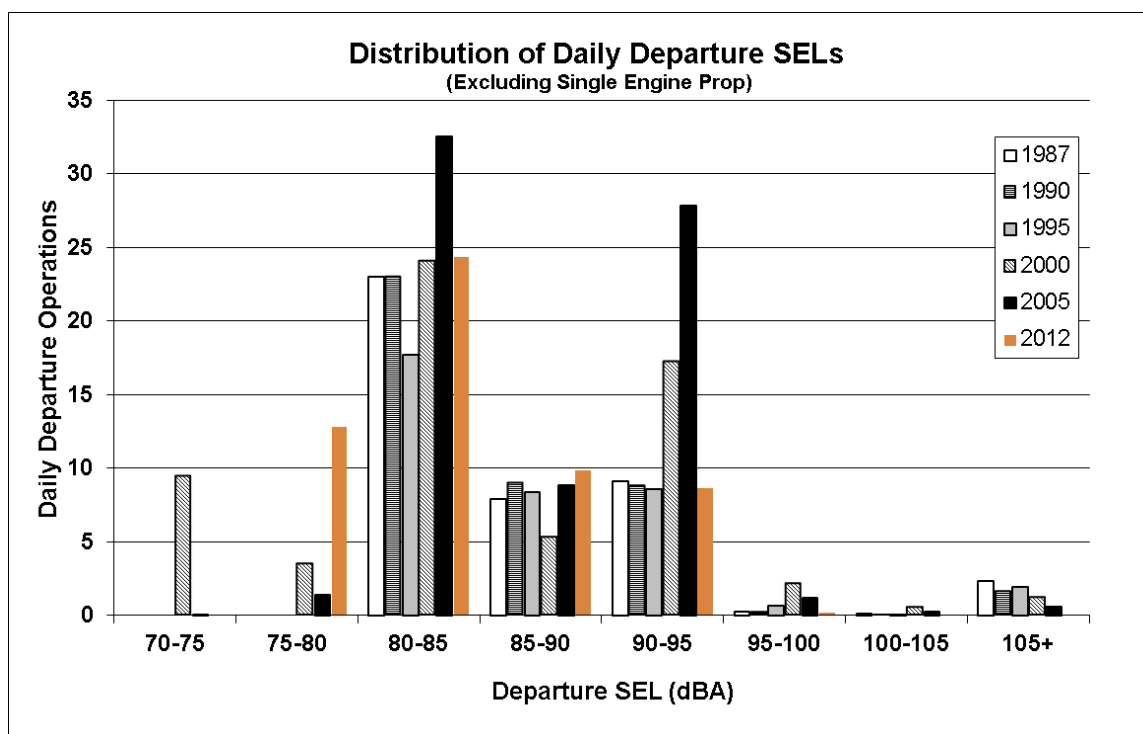


Figure 7-16 Historical Distribution of Daily Departure SELs (Excluding Single Engine Prop)

7.5.6 Aircraft Overflights of Minute Man National Historical Park

In 1991, Congress directed the National Park Service to conduct research on the impacts of aircraft overflying the National Park System in Public Law 100-91, the National Parks Overflights Act. The National Park Service issued Director's Order 47 (DO47) "Soundscape Preservation and Noise Management" in December 2000. The purpose of the order is to "articulate National Park Service operational policies that will require, to the fullest extent practicable, the protection, maintenance, or restoration of the natural soundscape resource in a condition unimpaired by inappropriate or excessive noise sources."

DO47 directs park managers to develop soundscape preservation and noise management plans that are consistent with the individual objectives for the park set forth in the Park General Management Plan. The individual park superintendent is tasked with identifying appropriate noise levels and criteria, as well as a plan for noise management and soundscape preservation. Massport met with National Park Service staff to discuss their soundscape preservation and noise management plans at Minute Man National Historical Park. At this time, the soundscape management plan for Minute Man National Historical Park has not been completed, though the National Park Service has begun its soundscape management planning process and collected noise measurements at several locations.

In order to address noise levels at various locations in Minute Man National Historical Park, thirty-one locations were included in the list of noise analysis locations. The sites that were included in the 2005

ESPR were reviewed and updated with input from the National Park Service. These locations are illustrated on Figure 7-11.

Table 7-20 presents the computed DNL at these sites for 2012. As shown in Table 7-20 and Figure 7-9, none of these thirty-one locations fell within either the 65 dB DNL or 55 dB DNL contours. No portion of the park fell within the 65 dB DNL contour or the 55 dB DNL contour. None of Historic Battle Road Interpretive Trail fell within either the 65 dB DNL or 55 dB DNL contours. As discussed earlier, Time Above computations with thresholds of 65 dBA and 55 dBA estimate the length of time during an average day in which people could experience outdoor speech interference at distances of three to four and ten to 15 feet, respectively. This is relevant to activities such as outdoor interpretive programs within Minute Man National Historical Park.

Table 7-21 and Table 7-22 present the time above 65 dBA and 55 dBA values for thirty-one points within Minute Man National Historical Park. Sites within the park experienced one to eight minutes per day with noise levels over 65 dBA. At the lower threshold of 55 dBA, the total time per day ranged from 12 to 84 minutes. The highest times above 55 dBA were in the range of 51 to 84 minutes per day and occurred in an area stretching from the western end of the Battle Road Unit at sites near Meriam's Corner to the Sgt. Samuel Hartwell House Site, directly south of the intersection of Runways 11/29 and 5/23. These are the closest sites in the Park to Hanscom Field's runways, and receive noise from several types of aircraft operations including departures turning south off of Runway 29, aircraft departing Runway 23, and pattern operations on Runway 11/29. The establishment of revised Touch-and-Go routes that limit flights over the MMNHP has contributed to a decrease in Time Above results.

Massport first developed a fly friendly program in 2001. This program encourages pilots to use the quietest flying techniques that are safe and practical. Inserts for pilot manuals continue to be made available for pilots of all aircraft (including commercial aircraft), outlining the Aircraft Owners and Pilot Association's and National Business Aircraft Association's quiet flying recommendations. Framed posters describing noise abatement procedures are hanging in the flight school offices and FBOs. Massport also periodically reminds these offices to encourage the pilots to use quiet flying techniques including through quarterly meetings.

Additionally, videos that discuss the concepts are incorporated into the training required to get a Hanscom security badge. As a result, pilots based at Hanscom are being exposed and re-exposed to the program, increasing awareness and an understanding of the quiet flying techniques. Security badges were instituted after September 11, 2001. There is a continued effort to implement multiple reminders to pilots to establish and maintain a culture of quiet flying.

In 2009, Massport began a new initiative to reduce noise over the Minute Man National Historical Park. Most touch-and-go operations circle to the south of the airport, potentially taking the aircraft over areas of the Battle Road Trail that are used by the Park for outdoor programs and interpretive talks. In a partnership with the Park, the FAA, the flight schools and Hanscom pilots, it was determined that small aircraft could increase the use of a tight touch-and-go pattern that keeps the aircraft over the airfield rather than over sensitive park areas.

Using radar data, Massport staff monitor the number of touch-and-go operations over the park. This data is a critical part of ongoing quarterly meeting between Massport, FAA air traffic control tower, and flight school staff to review touch and go flight paths. Since the initiation of this program, overflights over the park have been reduced by an average of 21%.

Table 7-20 2012 DNL at Noise Analysis Locations in the Minute Man National Historical Park (in dB)

Label		Name ³	Unit/Town ⁴	DNL Value		
2012 ¹	2005 ²			2000	2005 ²	2012
MM-1	MM-1	Major John Buttrick House	North Bridge Unit / Concord	51.9	51.2	48.7
MM-2	MM-2	NPS Headquarters and Visitor Center at 174 Liberty St. (Stedman Buttrick Residence)	North Bridge Unit / Concord	-	50.5	48.3
MM-3	MM-3	North Bridge Comfort Station	North Bridge Unit / Concord	51.4	50.3	48.2
MM-4	MM-4	The Minuteman (Statue)	North Bridge Unit / Concord	50.8	49.7	47.9
MM-5	MM-5	North Bridge	North Bridge Unit / Concord	50.9	49.9	48.0
MM-6	MM-6	Old Manse *	North Bridge Unit / Concord	51.4	50.2	48.1
MM-7	MM-7	The Wayside (Samuel Whitney House) *	Wayside Unit / Concord	52.6	53.6	50.3
MM-8	MM-8	Meriam's Corner Monument	Battle Road Unit / Concord	52.2	51.9	50.3
MM-9	MM-9	Meriam House	Battle Road Unit / Concord	52.7	52.1	50.6
MM-10	MM-10	Historic Farming Fields	Battle Road Unit / Concord	53.4	51.4	50.7
MM-11	MM-11	Olive Stow House/Farwell Jones House/Carty Barn	Battle Road Unit / Concord	50.5	50.5	49.2
MM-12	MM-12	Samuel Brooks House	Battle Road Unit / Concord	53.1	52.5	50.8
MM-13	MM-13	Noah Brooks Tavern (and Carriage House)	Battle Road Unit / Lincoln	54.2	53.4	51.4
MM-14	MM-14	Job Brooks House	Battle Road Unit / Lincoln	54.5	53.0	51.5
MM-15	MM-15	Joshua Brooks, Jr. House	Battle Road Unit / Lincoln	54.0	51.7	50.7
MM-16	MM-16	Bloody Angle	Battle Road Unit / Lincoln	51.4	50.1	50.9
MM-17	MM-17	Ephraim Hartwell Tavern	Battle Road Unit / Lincoln	48.3	47.8	49.2
MM-18	MM-18	Sgt. Samuel Hartwell House Site	Battle Road Unit / Lincoln	47.7	47.1	48.5
MM-19	MM-19	Captain William Smith House	Battle Road Unit / Lincoln	45.6	45.8	47.0
MM-20	MM-20	Paul Revere Capture Site and Marker	Battle Road Unit / Lincoln	45.5	45.2	45.8
MM-21	MM-21	Mile Three Location (Approximate)	Battle Road Unit / Lincoln	-	44.5	45.5
MM-22	MM-22	John Nelson House and Barn	Battle Road Unit / Lincoln	-	45.9	46.0
MM-23	MM-23	Josiah Nelson, Jr. House Foundation	Battle Road Unit / Lincoln	46.8	47.2	47.0
MM-24	MM-24	Thomas Nelson, Jr. House Foundation	Battle Road Unit / Lincoln	46.9	47.5	47.1
MM-25	MM-25	Parkers Revenge	Battle Road Unit / Lexington	46.6	47.6	47.0
MM-26	MM-26	Minute Man Visitor Center	Battle Road Unit / Lexington	45.3	46.9	46.1
MM-27	MM-27	Jacob Whittemore House	Battle Road Unit / Lexington	-	47.6	46.4
MM-28	MM-28	The Bluff and Monument	Battle Road Unit / Lexington	44.9	47.7	45.9
MM-29	MM-29	Mile Four Location (Approximate)	Battle Road Unit / Lexington	-	47.7	46.2
MM-30	MM-30	Ebenezer Fiske House Foundation	Battle Road Unit / Lexington	46.4	48.4	46.2
MM-31	-	Col. James Barrett Farm*	Barrett Farm Unit/Concord	-	-	43.5

Notes:

1. The Minute Man National Historical Park is a national historic landmark district. All sites are in the National Register of Historic Places.
2. The 2005 *ESPR* labels are provided for reference purposes. Blanks indicate new locations that have been added to the 2012 *ESPR* list of noise analysis locations.
3. Sites within Minute Man National Historical Park are marked with an asterisk (*) if they are individually listed in the National Register of Historic Places.
4. Sites in the Battle Road Unit are located on the Battle Road Interpretive Trail. MM-21 and MM-29 do not refer to specific historic resources, but provide additional coverage of sites along the Trail. MM-21 is approximately three miles east of Meriam's Corner and MM-29 is approximately four miles east of Meriam's Corner.

Table 7-21 2012 Time-Above 65 dBA at Noise Analysis Locations in the Minute Man National Historical Park

Label		Name ³	Unit/Town ⁴	TA-65 (Minutes)		
2012 ¹	2005 ²			2000	2005 ²	2012
MM-1	MM-1	Major John Buttrick House	North Bridge Unit / Concord	5.6	5.9	3.1
MM-2	MM-2	NPS Headquarters and Visitor Center at 174 Liberty St. (Stedman Buttrick Residence)	North Bridge Unit / Concord	-	5.1	2.8
MM-3	MM-3	North Bridge Comfort Station	North Bridge Unit / Concord	5.2	4.9	2.7
MM-4	MM-4	The Minuteman (Statue)	North Bridge Unit / Concord	4.3	4.5	2.5
MM-5	MM-5	North Bridge	North Bridge Unit / Concord	4.4	4.7	2.7
MM-6	MM-6	Old Manse *	North Bridge Unit / Concord	4.7	5.1	2.9
MM-7	MM-7	The Wayside (Samuel Whitney House) *	Wayside Unit / Concord	5.1	8.8	5.7
MM-8	MM-8	Meriam's Corner Monument	Battle Road Unit / Concord	6.5	8.4	5.7
MM-9	MM-9	Meriam House	Battle Road Unit / Concord	7.2	8.8	6.2
MM-10	MM-10	Historic Farming Fields	Battle Road Unit / Concord	11.8	8.0	7.0
MM-11	MM-11	Olive Stow House/Farwell Jones House/Carty Barn	Battle Road Unit / Concord	6.2	4.9	4.7
MM-12	MM-12	Samuel Brooks House	Battle Road Unit / Concord	7.2	4.2	6.6
MM-13	MM-13	Noah Brooks Tavern (and Carriage House)	Battle Road Unit / Lincoln	7.5	4.1	7.3
MM-14	MM-14	Job Brooks House	Battle Road Unit / Lincoln	7.7	4.4	8.0
MM-15	MM-15	Joshua Brooks, Jr. House	Battle Road Unit / Lincoln	7.1	4.0	7.1
MM-16	MM-16	Bloody Angle	Battle Road Unit / Lincoln	7.1	4.2	7.3
MM-17	MM-17	Ephraim Hartwell Tavern	Battle Road Unit / Lincoln	3.3	2.8	4.1
MM-18	MM-18	Sgt. Samuel Hartwell House Site	Battle Road Unit / Lincoln	2.5	2.1	2.9
MM-19	MM-19	Captain William Smith House	Battle Road Unit / Lincoln	1.0	1.2	1.5
MM-20	MM-20	Paul Revere Capture Site and Marker	Battle Road Unit / Lincoln	1.4	1.1	1.1
MM-21	MM-21	Mile Three Location (Approximate)	Battle Road Unit / Lincoln	-	0.8	1.0
MM-22	MM-22	John Nelson House and Barn	Battle Road Unit / Lincoln	-	1.4	1.3
MM-23	MM-23	Josiah Nelson, Jr. House Foundation	Battle Road Unit / Lincoln	2.3	2.2	1.8
MM-24	MM-24	Thomas Nelson, Jr. House Foundation	Battle Road Unit / Lincoln	2.3	2.6	1.9
MM-25	MM-25	Parkers Revenge	Battle Road Unit / Lexington	2.3	2.5	1.9
MM-26	MM-26	Minute Man Visitor Center	Battle Road Unit / Lexington	1.6	2.2	1.4
MM-27	MM-27	Jacob Whittemore House	Battle Road Unit / Lexington	-	2.8	1.6
MM-28	MM-28	The Bluff and Monument	Battle Road Unit / Lexington	1.4	2.9	1.5
MM-29	MM-29	Mile Four Location (Approximate)	Battle Road Unit / Lexington	-	2.8	1.6
MM-30	MM-30	Ebenezer Fiske House Foundation	Battle Road Unit / Lexington	1.7	3.6	2.0
MM-31	-	Col. James Barrett Farm*	Barrett Farm Unit/Concord	-	-	0.7

Notes:

1. The Minute Man National Historical Park is a national historic landmark district. All sites are in the National Register of Historic Places.
2. The 2005 *ESPR* labels are provided for reference purposes. Blanks indicate new locations that have been added to the 2012 *ESPR* list of noise analysis locations.
3. Sites within Minute Man National Historical Park are marked with an asterisk (*) if they are individually listed in the National Register of Historic Places.
4. Sites in the Battle Road Unit are located on the Battle Road Interpretive Trail. MM-21 and MM-29 do not refer to specific historic resources, but provide additional coverage of sites along the Trail. MM-21 is approximately three miles east of Meriam's Corner and MM-29 is approximately four miles east of Meriam's Corner.

Table 7-22 2012 Time-Above 55 dBA at Noise Analysis Locations in the Minute Man National Historical Park

Label		Name ³	Unit/Town ⁴	TA-55 (Minutes)		
2012 ¹	2005 ²			2000	2005 ²	2012
MM-1	MM-1	Major John Buttrick House	North Bridge Unit / Concord	26.4	38.5	26.6
MM-2	MM-2	NPS Headquarters and Visitor Center at 174 Liberty St. (Stedman Buttrick Residence)	North Bridge Unit / Concord	-	35.5	26.1
MM-3	MM-3	North Bridge Comfort Station	North Bridge Unit / Concord	24.8	34.5	25.8
MM-4	MM-4	The Minuteman (Statue)	North Bridge Unit / Concord	21.3	30.1	25.1
MM-5	MM-5	North Bridge	North Bridge Unit / Concord	21.5	31.0	25.8
MM-6	MM-6	Old Manse *	North Bridge Unit / Concord	22.0	30.6	26.3
MM-7	MM-7	The Wayside (Samuel Whitney House) *	Wayside Unit / Concord	29.9	43.8	34.4
MM-8	MM-8	Meriam's Corner Monument	Battle Road Unit / Concord	44.9	53.8	47.0
MM-9	MM-9	Meriam House	Battle Road Unit / Concord	49.4	55.6	51.0
MM-10	MM-10	Historic Farming Fields	Battle Road Unit / Concord	75.3	70.8	77.2
MM-11	MM-11	Olive Stow House/Farwell Jones House/Carty Barn	Battle Road Unit / Concord	53.2	53.2	57.1
MM-12	MM-12	Samuel Brooks House	Battle Road Unit / Concord	46.8	38.9	52.3
MM-13	MM-13	Noah Brooks Tavern (and Carriage House)	Battle Road Unit / Lincoln	44.3	34.8	51.1
MM-14	MM-14	Job Brooks House	Battle Road Unit / Lincoln	47.1	37.0	57.2
MM-15	MM-15	Joshua Brooks, Jr. House	Battle Road Unit / Lincoln	43.9	32.9	53.2
MM-16	MM-16	Bloody Angle	Battle Road Unit / Lincoln	64.9	46.9	84.4
MM-17	MM-17	Ephraim Hartwell Tavern	Battle Road Unit / Lincoln	47.0	42.9	72.5
MM-18	MM-18	Sgt. Samuel Hartwell House Site	Battle Road Unit / Lincoln	41.9	39.4	63.5
MM-19	MM-19	Captain William Smith House	Battle Road Unit / Lincoln	28.9	28.7	45.7
MM-20	MM-20	Paul Revere Capture Site and Marker	Battle Road Unit / Lincoln	15.9	21.0	31.0
MM-21	MM-21	Mile Three Location (Approximate)	Battle Road Unit / Lincoln	-	17.7	25.9
MM-22	MM-22	John Nelson House and Barn	Battle Road Unit / Lincoln	-	26.5	32.7
MM-23	MM-23	Josiah Nelson, Jr. House Foundation	Battle Road Unit / Lincoln	31.8	36.6	42.6
MM-24	MM-24	Thomas Nelson, Jr. House Foundation	Battle Road Unit / Lincoln	32.0	38.4	43.1
MM-25	MM-25	Parkers Revenge	Battle Road Unit / Lexington	29.9	38.2	41.1
MM-26	MM-26	Minute Man Visitor Center	Battle Road Unit / Lexington	18.9	31.6	31.3
MM-27	MM-27	Jacob Whittemore House	Battle Road Unit / Lexington	-	35.3	32.5
MM-28	MM-28	The Bluff and Monument	Battle Road Unit / Lexington	14.5	29.5	24.4
MM-29	MM-29	Mile Four Location (Approximate)	Battle Road Unit / Lexington	-	34.1	29.7
MM-30	MM-30	Ebenezer Fiske House Foundation	Battle Road Unit / Lexington	10.4	30.7	19.8
MM-31	-	Col. James Barrett Farm*	Barrett Farm Unit/Concord	-	-	11.9

Notes:

1. The Minute Man National Historical Park is a national historic landmark district. All sites are in the National Register of Historic Places.
2. The 2005 *ESPR* labels are provided for reference purposes. Blanks indicate new locations that have been added to the 2012 *ESPR* list of noise analysis locations.
3. Sites within Minute Man National Historical Park are marked with an asterisk (*) if they are individually listed in the National Register of Historic Places.
4. Sites in the Battle Road Unit are located on the Battle Road Interpretive Trail. MM-21 and MM-29 do not refer to specific historic resources, but provide additional coverage of sites along the Trail. MM-21 is approximately three miles east of Meriam's Corner and MM-29 is approximately four miles east of Meriam's Corner.

7.6 Analysis of Future Scenarios

All aspects of model input required for the 2012 calculations were also necessary for analysis of future impacts. No changes were made to the airfield layout, flight tracks, runway use, or aircraft noise and performance data for the future cases. Only the operations data, which consist of the types of aircraft and number of operations, were changed.

The 2012 *ESPR* future scenarios are used to evaluate the potential cumulative environmental effects that could occur if Hanscom Field reaches the airport activity levels that are described in Chapter 3, Airport Activity Levels. The 2020 and 2030 scenarios represent estimates of what could occur (not what will occur) in the future using certain planning assumptions and are not necessarily recommended outcomes. The future service scenarios are consistent with Massport's 1980 Regulations for Hanscom Field, which prohibit scheduled commercial passenger services with aircraft having more than 60 seats. Table 7-23 summarizes the average daily operations for the two forecast scenarios. A more detailed breakdown of operations by individual aircraft types is included for each scenario in Appendix D.

Table 7-23 Forecast Average Daily Operations

Group	Departures		Arrivals		Total
	Daytime (7:00 a.m. to 10:00 p.m.)	Nighttime (10:00 p.m. to 7:00 a.m.)	Daytime (7:00 a.m. to 10:00 p.m.)	Nighttime (10:00 p.m. to 7:00 a.m.)	
2020					
Stage 2 Jets	0.0	0.0	0.0	0.0	0.0
Stage 3 Jets	44.1	2.5	42.7	3.8	93.1
Turbo Prop	5.0	0.1	5.0	0.2	10.4
Piston	165.7	0.5	165.4	0.8	332.4
Military	1.0	0.0	1.0	0.0	2.0
Helicopters	10.0	0.2	10.0	0.2	20.5
All Groups	225.9	3.3	224.2	5.0	458.4
2030					
Stage 2 Jets	0.0	0.0	0.0	0.0	0.0
Stage 3 Jets	58.8	3.3	57.0	5.1	124.3
Turbo Prop	6.5	0.9	6.4	0.2	14.0
Piston	182.1	0.6	181.8	0.9	365.4
Military	1.0	0.0	1.0	0.0	2.0
Helicopters	10.0	0.2	10.0	0.2	20.5
All Groups	258.5	5.0	256.2	6.5	526.2

7.6.1 DNL Contours

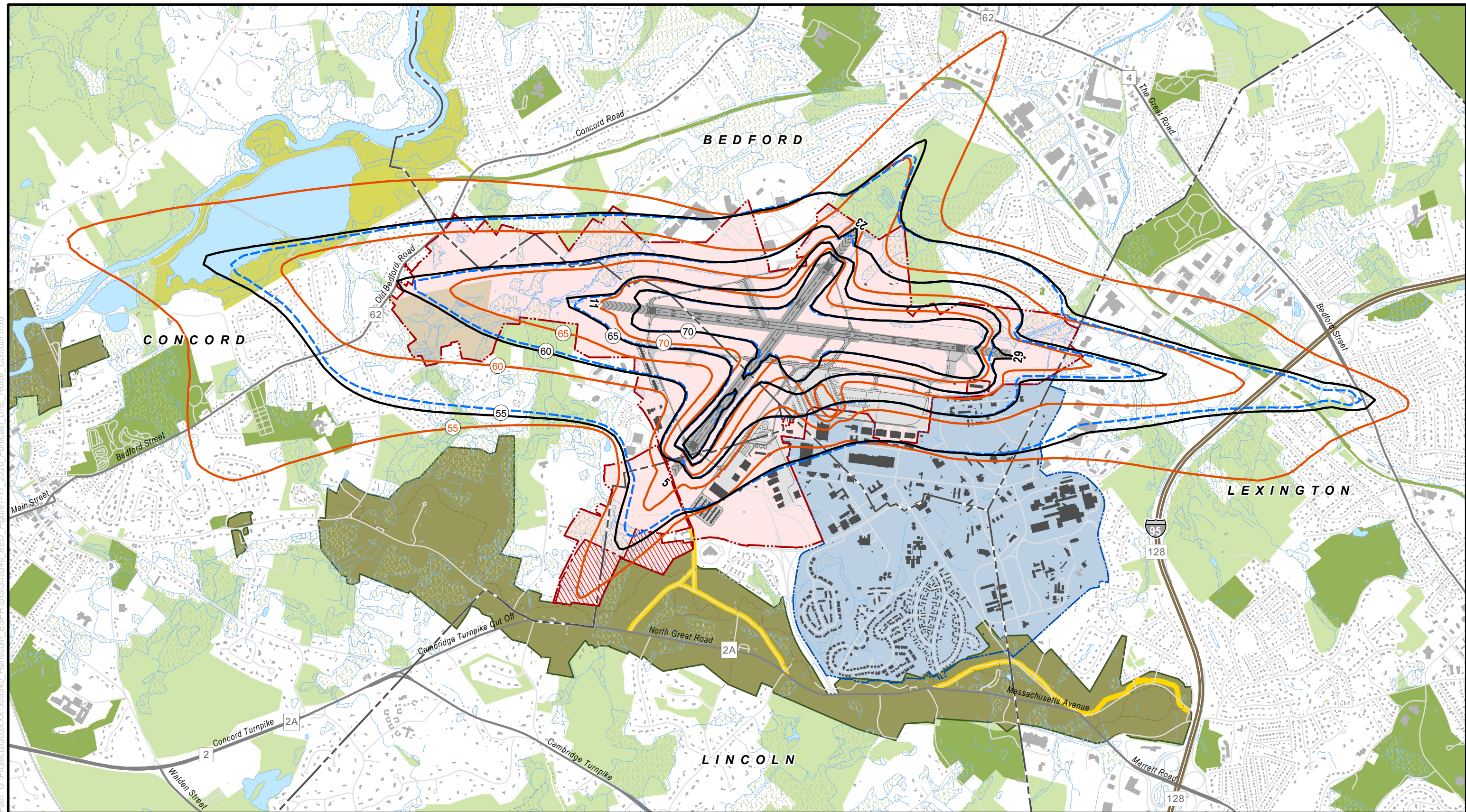
Figure 7-17 and Figure 7-18 depict the 55, 60, 65, and 70 dB DNL contours for the two future scenarios. In each figure the 2005 and 2012 contours are also shown for comparison. In both figures, the area within each contour level increases in the future scenarios, but remains confined within the 2005 contour. The growth in the contours occurs fairly evenly. Another notable feature is the growth in the contour despite phase out of operations by the older, noisier Stage 2 aircraft such as the Lear 25. The overall increase in operations offsets any reductions resulting from fleet mix changes. The area within each contour interval is presented in Table 7-24 for 2005 and 2012 for comparison to the forecast years of 2020 and 2030. The data show that DNL contours for 2020 is only increase marginally above 2012 and contours for 2030 will affect less area than in 2005.

Table 7-24 Forecast Area within DNL Contours

DNL Contours (dB)	Cumulative Area (Acres)			
	2005	2012	2020	2030
70	311	190	195	222
65	635	391	400	457
60	1,437	857	890	1,043
55	3,291	2,045	2,159	2,585

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- 2005 DNL Noise Contour
- 2012 DNL Noise Contour
- 2020 DNL Noise Contour
- Hanscom Field Property Boundary
- Massport Property within MMNHP Congressional Boundary
- Hanscom AFB Property Boundary

- Municipal Boundary
- Historic Road
- Interstate
- Highway
- Road
- Trail
- Active Rail Service

- Open Water
- Wetland/Marsh
- MMNHP Boundary
- Great Meadows
- Open Space Non-protected
- Open Space Protected in Perpetuity



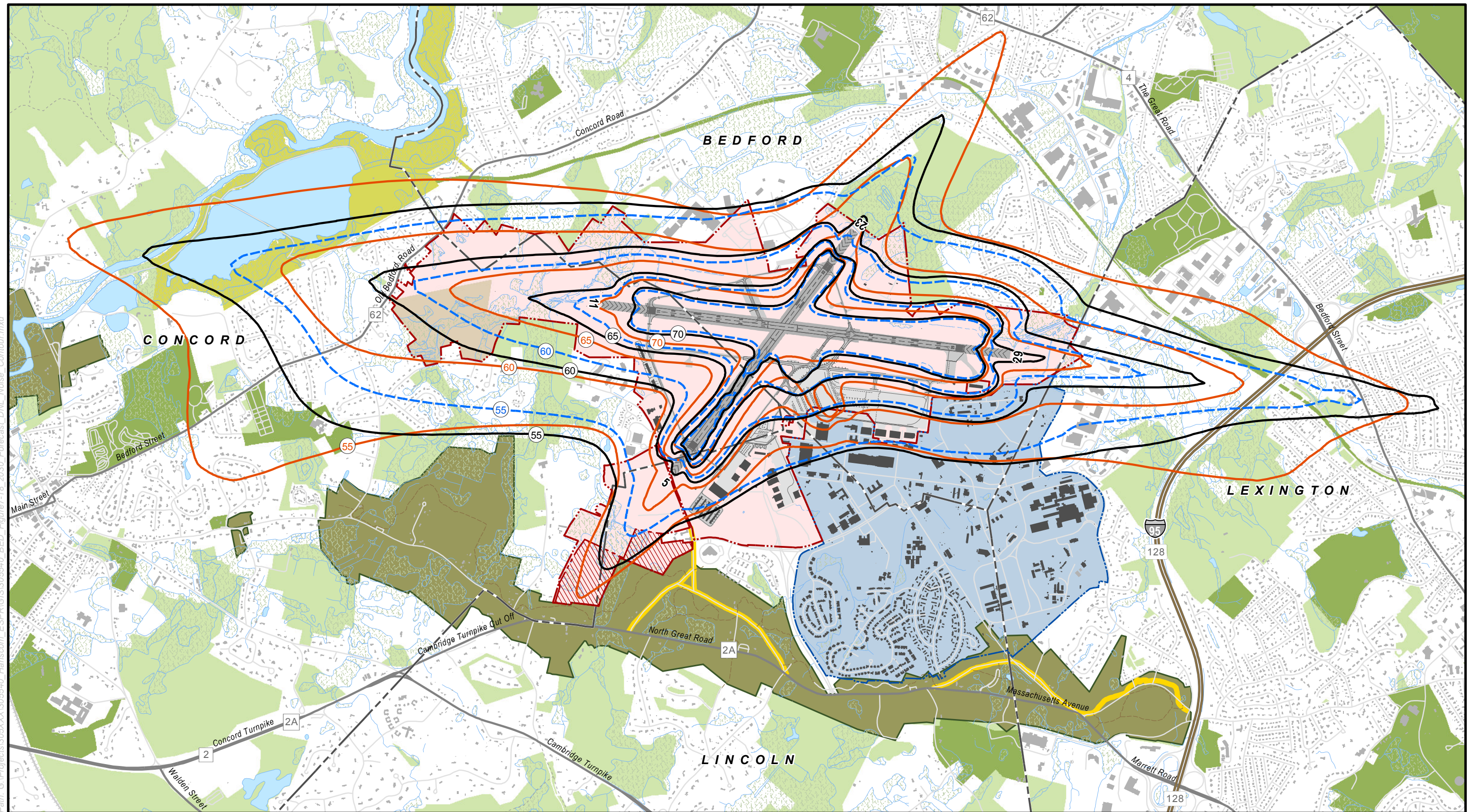
Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

2005 and 2012 DNL Noise Contours Compared to 2020 Forecast DNL Noise Contours
Figure 7-17

Data Sources: MassGIS (Roads, Rail), March 5, 2013; MassGIS (Bike Trails, Tracks and Trails), March 7, 2013; MassGIS (Community Boundaries), March 5, 2013; MassGIS (DEP Wetlands), March 8, 2013; NPS (Park Boundary), March 8, 2013; NPS (Streets and Trails), March 8, 2013; MassGIS (Building Footprints), March 7, 2013

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- 2005 DNL Noise Contour
- 2012 DNL Noise Contour
- 2030 DNL Noise Contour
- Hanscom Field Property Boundary
- Massport Property within MMNHP Congressional Boundary
- Hanscom AFB Property Boundary

- Municipal Boundary
- Historic Road
- Interstate
- Highway
- Road
- Trail
- Active Rail Service

- Open Water
- Wetland/Marsh
- MMNHP Boundary
- Great Meadows
- Open Space Non-protected
- Open Space Protected in Perpetuity



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

2005 and 2012 DNL Noise Contours Compared to 2030 Forecast DNL Noise Contours
Figure 7-18

Data Sources: MassGIS (Roads, Rail), March 5, 2013; MassGIS (Bike Trails, Tracks and Trails), March 7, 2013; MassGIS (Community Boundaries), March 5, 2013; MassGIS (DEP Wetlands), March 8, 2013; NPS (Park Boundary), March 8, 2013; NPS (Streets and Trails), March 8, 2013; MassGIS (Building Footprints), March 7, 2013

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7.6.2 Residential Land Use Impacts

Population estimates were prepared for the forecast cases using year 2010 U.S. Census data and the same Geographic Information Systems (GIS) techniques described previously for the 2012 operating conditions. Table 7-25 presents the population within the 55, 60, 65, and 70 dB DNL contours for the forecast cases in 2020 and 2030. The values calculated for 2005 and 2012 are included for comparison. The areas of future growth in the contours relative to 2012 shown in Figure 7-17 and Figure 7-18 are reflected in Table 7-25. In the future, the population between the 55 dB and 60 dB DNL contours is projected to increase in Bedford, Concord, and Lexington and the population between the 60 dB and 65 dB DNL contours is projected to increase in Bedford and Concord relative to 2012. In both forecast years the population within the 65 dB DNL contour remains zero in all four towns. No population in Lincoln is exposed to a DNL of 55 dB or higher in either of the future scenarios. Population affected by specific contour intervals in 2012 was smaller than occurred in 2005 and will continue to be smaller in both 2020 and 2030 than occurred in 2005.

Table 7-25 U.S. Census Population Counts within Current and Forecast DNL Contours

Town	Total Population between DNL Contours:				
	70 dB or Greater	65 to 70 dB	60 to 65 dB	55 to 60 dB	Total 55 dB or Greater
2005					
Bedford	0	17	256	872	1,145
Concord	0	0	209	1,075	1,284
Lexington	0	0	0	524	524
Lincoln	0	0	0	0	0
Total	0	17	465	2,471	2,953
2012					
Bedford	0	0	87	369	456
Concord	0	0	0	542	542
Lexington	0	0	0	43	43
Lincoln	0	0	0	0	0
Total	0	0	87	954	1,041
2020					
Bedford	0	0	91	400	491
Concord	0	0	2	594	596
Lexington	0	0	0	89	89
Lincoln	0	0	0	0	0
Total	0	0	93	1,083	1,176
2030					
Bedford	0	0	128	510	638
Concord	0	0	23	840	863
Lexington	0	0	0	358	358
Lincoln	0	0	0	0	0
Total	0	0	151	1,708	1,859

7.6.3 DNL for Existing and Forecasts Years at Noise Analysis Locations by Town

Table 7-26 through Table 7-29 present the INM-computed DNL values at the noise analysis locations in the vicinity of Hanscom Field for the two forecast scenarios. The values calculated for 2012 are included for comparison. The tables show consistent results with the DNL contours and population assessments. The 2030 forecast scenario would yield the highest DNL values.

While all future contour areas, population counts, and noise levels at noise analysis locations are predicted to increase relative to the year 2012, the importance of any differences from one scenario to the next depends both on the absolute value of the projected DNL as well as on the magnitude of the change. Noise impact criteria are used to determine areas for further analysis and possible mitigation when completing environmental documentation for a specific project at an airport. Though the *2012 ESPR* is not an environmental permitting document for a specific project, the use of these criteria help to highlight notable changes in the noise environment at Hanscom Field.

FAA Order 1050.1E CHG1, "Environmental Impacts: Policies and Procedures"³⁵, identifies a change of 1.5 dB or more at a "noise-sensitive area"³⁶ as a threshold for further analysis. FICON clarifies the FAA position by recommending a tiered approach be used to screen noise impacts. The 1.5 dB threshold of significance for noise-sensitive areas within the 65 dBA DNL contour is used for initial screening, but if such changes are found to occur, additional analysis of noise analysis locations is to be conducted between DNL values of 60 and 65 dBA to determine whether those noise analysis locations would experience changes of three or more dB. Such sites, if they are found to exist, are eligible for federal agency mitigation options.³⁷

No noise analysis locations are exposed to a DNL of 60 dBA or above. From two to three sites would be exposed to DNL values between 55 and 60 dBA depending upon the scenario. The higher number of locations is associated with the 2030 scenario.

³⁵U.S. Department of Transportation, Federal Aviation Administration, Office of Environment and Energy, Environmental Impacts: Policies and Procedures, FAA Order 1050.1E CHG1, Washington, DC.

³⁶Using FAA guidelines, "noise-sensitive areas" are generally assumed to be residential areas within the DNL 65 dB contour.

³⁷Federal Interagency Committee on Noise, Federal Agency Review of Selected Airport Noise Analysis Issues, August 1992. FICON did not address noise levels below DNL 60 dBA because it considered noise predictions below that level to be less reliable.

Table 7-26 Existing and Forecast DNL at Noise Analysis Locations in Bedford (in dB)

Label ¹	Name ²	Address/Town	2012	2020	2030
HB-1	Veterans Administration Medical Center*	200 Springs Rd, Bedford	41.8	42.2	43.2
NB-1	Bedford Historic District	Great Rd., Bedford	44.6	44.8	45.7
NB-2	Old Bedford Center Historic District	Great Rd., Bedford	45.4	45.7	46.7
NB-3	Old Burying Ground	7 Springs Rd., Bedford	45.7	46.1	47.1
NB-4	Old Town Hall	16 South Rd., Bedford	46.1	46.5	47.4
NB-5	Bedford Depot Park Historic District	80 Loomis St./120 South Rd., Bedford	49.8	50.3	51.3
NB-6	Nathaniel Page House	89 Page Rd., Bedford	45.9	46.5	47.5
NB-7	Christopher Page House	50 Old Billerica Rd., Bedford	44.2	44.8	45.8
NB-8	Bacon-Gleason-Blodgett Homestead	118 Wilson Rd., Bedford	41.5	42.0	43.0
NB-9	Historic Wilson Mill-Old Burlington Road Historic Dist.	Old Burlington and Wilson Rds., Bedford	41.3	41.8	42.8
NB-10	Shawsheen Cemetery **	Shawsheen Rd., Bedford	45.2	45.4	46.7
NB-11	David Lane House	137 North Rd., Bedford	42.1	42.5	43.4
OB-1	Old Billerica Road Area ** (NR nomination form in process)	Old Billerica Rd, Bedford	44.0	44.7	45.7
PB-1	Town Hall *	10 Mudge Way, Bedford	45.5	45.8	46.7
PB-2	Library **	7 Mudge Way, Bedford	45.0	45.2	46.1
PB-3	Bedford School District	11Mudge Way, Bedford	45.6	45.8	46.7
PB-4	Department of Public Works	314 Great Rd., Bedford	45.4	45.6	46.9
RB-1	The Lutheran Church of the Savior	426 Davis Rd., Bedford	48.6	48.8	49.8
RB-2	First Baptist Church of Bedford	155 Concord Rd., Bedford	46.0	46.0	46.8
RB-3	St. Michael's Church	90 Concord Rd., Bedford	44.9	45.0	45.7
RB-4	Boston Buddha Vararam Temple	125 North Rd., Bedford	42.2	42.6	43.5
RB-5	The First Church of Christ Congregational/ United Church of Christ *	25 Great Rd., Bedford	45.1	45.4	46.3
RB-6	The First Parish in Bedford Unitarian Universalist *	75 Great Rd., Bedford	46.0	46.3	47.3
RB-7	St. Paul's Episcopal Church	100 Pine Hill Rd., Bedford	41.8	42.2	43.1
RB-8	March for Jesus	54 Summer St., Bedford	52.2	52.5	53.4
RB-9	Immanuel Baptist Church/ Zion Korean Alliance Church ³	400 Great Rd., Bedford	45.8	46.1	47.3
SB-1	Davis School	Davis Rd., Bedford	43.1	43.2	44.0
SB-2	Bedford High School **	9 Mudge Way, Bedford	45.1	45.3	46.1
SB-3	John Glenn Middle School	99 McMahan Rd., Bedford	46.7	46.7	47.5

Notes:

1. The first letter of the label indicates the nature of each site: H for hospital, N for sites in the National Register of Historic Places and/or State Register of Historic Places, O for other, P for public facilities, R for religious sites, S for schools. Other is the category for sites that town representatives specifically requested be added to the noise analysis location list, but do not fit into the other four categories. The second letter indicates the town where the site is located: B for Bedford, C for Concord, LX for Lexington, LN for Lincoln.

2. Historic districts and cemeteries are evaluated at a central location within the district or cemetery. Sites that are not designated as "N" sites are marked with an asterisk (*) if they are listed in the National Register of Historic Places and two asterisks (**) if they are listed in the State Inventory/MACRIS. Sites are marked with a (†) if they are only listed in the State Register of Historic Places. Sites marked with a (††) contribute to the Old Bedford Center Historic District.

3. The Immanuel Baptist Church and Zion Korean Alliance Church are at the same address.

4. The boundary of the Old Bedford Center Historic District has slightly expanded, the Old Bedford Center Historic District Boundary Extension, since the last study in 2005.

Table 7-27 Existing and Forecast DNL at Noise Analysis Locations in Concord (in dB)

Label ¹	Name ²	Address/Town	2012	2020	2030
NC-1	Barrett Farm Historic District†	Barrett's Mill Rd., Concord	43.5	43.9	44.9
NC-2	Jonathan Hildreth House	8 Barrett's Mill Rd., Concord	47.4	48.2	49.1
NC-3	Joseph Hosmer House	572 Main St., Concord	44.3	43.9	45.1
NC-4	Thoreau-Alcott House	255 Main St., Concord	46.1	46.1	47.4
NC-5	Hubbardville Historic District†	324-374 Sudbury Rd., Concord	46.5	46.6	47.9
NC-6	Hubbard-French Historic District	324-374 Sudbury Rd., Concord	46.5	46.6	47.9
NC-7	Deacon Thomas Hubbard/ Judge Henry French House	342 Sudbury Rd., Concord	46.4	46.5	47.8
NC-8	Pest House	158 Fairhaven Rd., Concord	46.3	46.5	47.8
NC-9	Main Street Historic District†	Main St. between Monument Sq. and Wood St., Concord	48.0	48.1	49.4
NC-10	North Bridge-Monument Square Historic District†	Monument St., Liberty St. and Lowell St., Concord	48.2	48.2	49.4
NC-11	Wright Tavern	Lexington Rd. & Main St., Concord	48.2	48.3	49.5
NC-12	Sleepy Hollow Cemetery	24 Court Ln., Concord	49.0	49.2	50.4
NC-13	American Mile Historic District†	Lexington Rd., Concord	48.5	48.7	49.9
NC-14	Concord Monument Square-Lexington Road Historic District	Monument Sq. and Lexington Rd., Concord	48.1	48.2	49.4
NC-15	Ralph Waldo Emerson House	28 Cambridge Turnpike, Concord	49.1	49.3	50.5
NC-16	Walden Pond ³	MA Rte 126 (Main Beach), Concord	43.4	43.8	44.9
NC-17	Orchard House	399 Lexington Rd., Concord	50.2	50.4	51.6
NC-18	Deacon John Wheeler/ Capt. Jonas Minot Farmhouse	341 Virginia Rd., Concord	58.4	58.7	59.8
NC-19	Wheeler-Meriam House	477 Virginia Rd., Concord	58.1	58.4	59.4
NC-20	Concord Armory-Concord Veteran's Building	51 Walden St., Concord	48.1	48.2	49.5
NC-21	Concord School of Philosophy	391 Lexington Rd., Concord	50.3	50.6	51.8
NC-22	Hosmer Homestead	138 Baker Ave., Concord	41.6	41.3	42.3
PC-1	Library **	129 Main St., Concord	47.1	47.2	48.4
PC-2	Town Hall ††	22 Monument Sq., Concord	48.1	48.2	49.4
PC-3	Middlesex County Court House	305 Walden St., Concord	48.4	48.6	49.9
RC-1	Trinity Episcopal Church **	81 Elm St., Concord	45.0	44.8	46.0
RC-2	Redeemer Presbyterian Church	191 Sudbury Rd., Concord	46.7	46.8	48.0
RC-3	New Life Community Church (meeting at the Emerson School Building **)	40 Stow St., Concord	47.4	47.5	48.7
RC-4	Trinitarian Congregational Church **	54 Walden St., Concord	48.0	48.1	49.3
RC-5	First Church of Christ Scientist††	7 Lowell Rd., Concord	47.7	47.8	49.0
RC-6	St. Bernard's Parish††	70 Monument Square, Concord	47.9	48.0	49.2
RC-7	Christian Science Reading Room	20 Main St., Concord	47.9	48.0	49.3
RC-8	First Parish in Concord ††	20 Lexington Rd., Concord	48.2	48.3	49.6
SC-1	Nashoba/Brooks School	200 Strawberry Hill Rd., Concord	46.5	47.3	48.3
SC-2	Middlesex School**	1400 Lowell Rd., Concord	40.4	40.9	41.7
SC-3	Fenn School **	498-516 Monument St., Concord	50.9	51.6	52.5
SC-4	Concord Academy **	166 Main St., Concord	46.6	46.6	47.8
SC-5	Alcott School	91 Laurel Rd., Concord	48.1	48.3	49.6
SC-6	Concord/Carlisle High School	500 Walden Rd., Concord	46.8	47.0	48.3
SC-7	Ripley School	120 Meriam Rd., Concord	53.6	53.8	55.0

Notes:

1. The first letter of the label indicates the nature of each site: H for hospital, N for sites in the National Register of Historic Places and/or State Register of Historic Places, O for other, P for public facilities, R for religious sites, S for schools. Other is the category for sites that town representatives specifically requested be added to the noise analysis location list, but do not fit into the other four categories. The second letter indicates the town where the site is located: B for Bedford, C for Concord, LX for Lexington, LN for Lincoln.

2. Historic districts and cemeteries are evaluated at a central location within the district or cemetery. Sites that are not designated as "N" sites are marked with an asterisk (*) if they are listed in the National Register of Historic Places and two asterisks (**) if they are listed in the State Inventory/MACRIS. Sites are marked with a (†) if they are only listed in the State

Label ¹	Name ²	Address/Town	2012	2020	2030
Register of Historic Places. Sites marked with a (††) contribute to the Concord Monument Square-Lexington Road Historic District.					
3. The Walden Pond State Reservation is located in Concord and Lincoln. This site is at the main beach in Concord.					

Table 7-28 Existing and Forecast DNL at Noise Analysis Locations in Lexington (in dB)

Label ¹	Name ²	Address/Town	2012	2020	2030
NLX-1	Simonds Tavern	331 Bedford St., Lexington	53.0	53.6	54.7
NLX-2	Hancock-Clarke Historic District†	Hancock St., Lexington	42.8	43.1	44.3
NLX-3	Hancock-Clarke House	35 Hancock St., Lexington	42.6	42.9	44.1
NLX-4	Garrity House	9 Hancock St., Lexington	42.7	43.0	44.3
NLX-5	Lexington Green Historic District	Mass. Ave., Harrington Rd. and Bedford St., Lexington	42.9	43.2	44.5
NLX-6	Lexington Green	Mass. Ave., Harrington Rd. and Bedford St., Lexington	42.7	43.1	44.3
NLX-7	Buckman Tavern	1 Bedford St., Lexington	42.5	42.8	44.1
NLX-8	General Samuel Chandler House	8 Goodwin Rd., Lexington	42.5	42.8	44.1
NLX-9	Hancock School	33 Forest St., Lexington	42.6	43.0	44.3
NLX-10	U.S. Post Office Building	1661 Mass. Ave., Lexington	40.8	41.1	42.5
NLX-11	Warren E. Shelburne House	11 Percy Rd., Lexington	38.4	38.8	40.3
NLX-12	Munroe Tavern Historic District†	Mass. Ave., Lexington	36.6	36.9	38.6
NLX-13	Sanderson House-Munroe Tavern	1314 & 1332 Mass. Ave., Lexington	37.4	37.8	39.3
NLX-14	John Mason House	1303 Mass. Ave., Lexington	37.7	38.0	39.6
NLX-15	East Village Historical District†	Mass Ave., Lexington	35.3	35.6	37.3
NLX-16	M.H. Merriam and Company	7-9 Oakland Ave., Lexington	41.6	41.9	43.2
OLX-1	Battle Green Historic District**	Worthen Rd., Woburn St., Hastings Rd., Mass. Ave. and B&M Railroad, Lexington	42.8	43.1	44.4
OLX-2	National Heritage Museum	33 Marrett Rd., Lexington	36.2	36.5	38.2
PLX-1	Library **	1874 Mass. Ave., Lexington	43.1	43.5	44.7
PLX-2	Town Hall **	1625 Mass. Ave., Lexington	39.3	39.6	41.0
PLX-3	Lexington School District Administration **	1557 Massachusetts Ave., Lexington	40.0	40.3	41.7
RLX-1	Lexington United Methodist Church/ St. John's Korean United Methodist Church ³	2600 Massachusetts Ave., Lexington	45.9	46.5	47.7
RLX-2	Temple Isaiah	55 Lincoln St., Lexington	44.2	44.7	45.9
RLX-3	Grace Chapel of Lexington	59 Worthen Rd., Lexington	44.6	44.9	46.1
RLX-4	St. Brigid's Parish *	2001 Mass. Ave., Lexington	44.0	44.3	45.5
RLX-5	First Parish-Unitarian Church††	7 Harrington Rd., Lexington	43.2	43.6	44.8
RLX-6	Hancock United Church of Christ ††	1912 Mass. Ave., Lexington	43.0	43.3	44.6
RLX-7	Church of Our Redeemer	6 Meriam St., Lexington	42.3	42.7	43.9
RLX-8	Christian Science Reading Room	10 Muzzy St. #12, Lexington	41.8	42.2	43.5
RLX-9	Greek Orthodox Church of St. Nichols **	17 Meriam St., Lexington	42.0	42.3	43.5
RLX-10	Chabad Center **	9 Burlington St., Lexington	49.9	50.3	51.4
RLX-11	Pilgrim Congregational Church	55 Coolidge Ave., Lexington	44.9	45.1	46.2
RLX-12	First Baptist Church of Lexington **	1580 Mass. Ave., Lexington	40.1	40.4	41.8
RLX-13	Jehovah's Witnesses	196 Woburn St., Lexington	36.7	36.8	38.2
RLX-14	Follen Church Society- Unitarian Universalists *	755 Massachusetts Ave., Lexington	34.0	34.2	35.9
RLX-15	Countryside Bible Chapel	480 Lowell St., Lexington	37.3	37.4	38.5
RLX-16	St. Paul Evangelical Church	451 Lowell St., Lexington	36.2	36.3	37.5
SLX-1	Minuteman Regional Vocational High School	758 Marrett Rd., Lexington	44.8	45.1	46.0
SLX-2	Maria Hastings School	2618 Mass. Ave., Lexington	45.4	46.0	47.2
SLX-3	Methodist Weekday School	2600 Massachusetts Ave., Lexington	46.0	46.6	47.7
SLX-4	Community Nursery School	2325 Massachusetts Ave., Lexington	45.8	46.3	47.4
SLX-5	Bridge Elementary School**	55 Middleby Rd., Lexington	42.2	42.8	44.2
SLX-6	Lexington High School	251 Waltham St., Lexington	41.7	42.3	43.6

Label ¹	Name ²	Address/Town	2012	2020	2030
SLX-7	Jonas Clarke Middle School	17 Stedman Rd., Lexington	37.6	38.1	39.7
SLX-8	Estabrook School**	117 Grove St., Lexington	44.5	45.1	46.4
SLX-9	Diamond Middle School	99 Hancock St., Lexington	50.1	50.5	51.6
SLX-10	Fiske Elementary School	146 Maple St., Lexington	42.4	42.5	43.6
SLX-11	Armenian Sisters Academy	20 Pelham Rd., Lexington	37.2	37.6	39.2
SLX-12	Harrington Elementary School	148 Maple St., Lexington	33.5	33.7	35.3

Notes:

1. The first letter of the label indicates the nature of each site: H for hospital, N for sites in the National Register of Historic Places and/or State Register of Historic Places, O for other, P for public facilities, R for religious sites, S for schools. Other is the category for sites that town representatives specifically requested be added to the noise analysis location list, but do not fit into the other four categories, or historic districts that are not on the National Register of Historic Places. The second letter indicates the town where the site is located: B for Bedford, C for Concord, LX for Lexington, LN for Lincoln.

2. Historic districts and cemeteries are evaluated at a central location within the district or cemetery. Sites that are not designated as "N" sites are marked with an asterisk (*) if they are listed in the National Register of Historic Places and two asterisks (**) if they are listed in the State Inventory/MACRIS. Sites are marked with a (†) if they are only listed in the State Register of Historic Places. Sites marked with a (††) contribute to the Lexington Green Historic District.

3. The Lexington United Methodist Church and St. John's Korean United Methodist Church are at the same address.

Table 7-29 Existing and Forecast DNL at Noise Analysis Locations in Lincoln (in dB)

Label ¹	Name ²	Address/Town	2012	2020	2030
NLN-1	Walden Pond ³	Rte. 126, Walden St., Concord Rd., Lincoln	42.6	43.0	44.1
NLN-2	Henry Higginson House	44 Baker Farm Rd., Lincoln	42.5	43.0	44.1
NLN-3	Daniel Brooks House	Brooks Rd., Lincoln	48.4	49.1	50.0
NLN-4	Lincoln Center Historic District	Bedford Rd. Lincoln Rd., Old Lexington Rd. Sandy Pond Rd. Trapelo Rd. Weston Rd., Lincoln	41.0	41.2	42.0
NLN-5	Hoar Tavern	268 Cambridge Tpke., Lincoln	41.8	42.2	43.3
SLN-1	Carroll School	25 Baker Bridge Rd., Lincoln	40.8	41.2	42.2
SLN-2	Hanscom Middle School	Hanscom AFB, Lincoln	50.2	50.1	50.7

Notes:

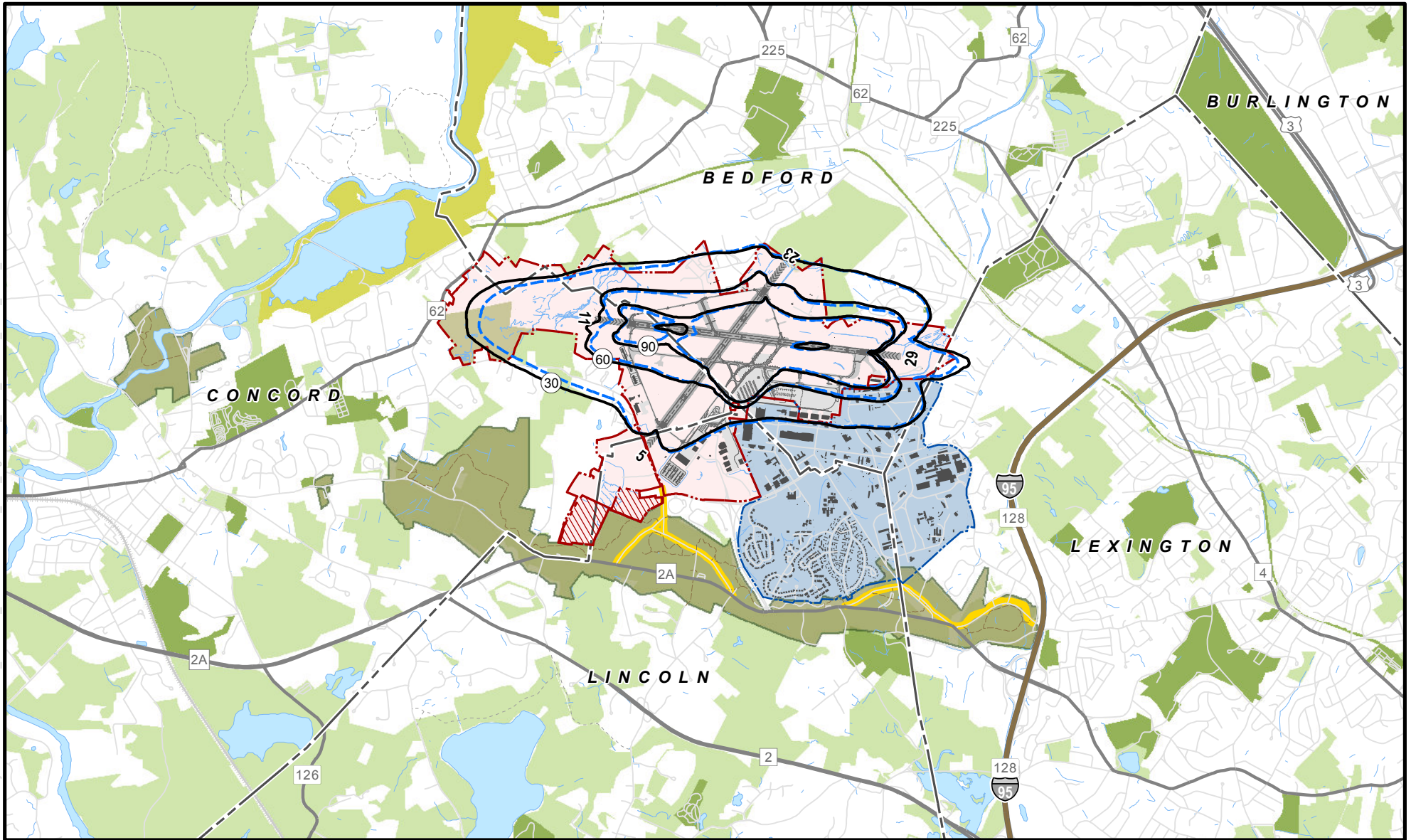
1. The first letter of the label indicates the nature of each site: H for hospital, N for sites in the National Register of Historic Places and/or State Register of Historic Places, O for other, P for public facilities, R for religious sites, S for schools. Other is the category for sites that town representatives specifically requested be added to the noise analysis location list, but do not fit into the other four categories. The second letter indicates the town where the site is located: B for Bedford, C for Concord, LX for Lexington, LN for Lincoln.

2. Historic districts and cemeteries are evaluated at a central location within the district or cemetery. Sites that are not designated as "N" sites are marked with an asterisk (*) if they are listed in the National Register of Historic Places and two asterisks (**) if they are listed in the State Inventory/MACRIS.

3. The Walden Pond State Reservation is located in Concord and Lincoln. This site at the main beach in Concord.

7.6.4 Time Above (TA)

The amount of time that aircraft noise is projected to be above the 65 and 55 dBA thresholds was also computed for the two forecast scenarios using the INM. Figure 7-19 through Figure 7-22 display the contours for areas where aircraft noise exceeds each threshold of 65 and 55 dBA for 30, 60, and 90 minutes per day for each future scenario. Each figure also includes the 2012 contours for comparison. The cumulative area within each contour interval is presented for each forecast scenario in Table 7-30, with 2012 values for comparison. TA increases in area coverage for both the 65 and 55 dBA thresholds overtime which is expected with increasing activity levels. The table shows existing and future levels as well as those for 2005 for comparison. This shows that 2020 levels will be similar to 2005 (above for 60 and 90 minute threshold but below for 30 minute) and then will uniformly increase for 2030. Table 7-31 presents the population estimates for the forecast cases using the same techniques described earlier for the DNL contours. The impacts of TA thresholds on population will be similar to area, that is 2020 will be similar to what was experienced in 2005 and then will increase from 2005 levels in 2030. Appendix D provides additional detail on the methodology.



- | | | | | | |
|--|---|--|---------------------|--|------------------------------------|
| | 2020 Time Above 65 dBA Contours (Minutes) | | Historic Road | | MMNHP Boundary |
| | 2012 Time Above 65 dBA Contours (Minutes) | | Interstate | | Great Meadows |
| | Hanscom Field Property Boundary | | Highway | | Open Space Non-protected |
| | Massport Property within MMNHP Congressional Boundary | | Road | | Open Space Protected in Perpetuity |
| | Hanscom AFB Property Boundary | | Trail | | Open Water |
| | Municipal Boundary | | Active Rail Service | | Stream |

Data Sources: MassGIS (Roads, Rail), March 5, 2013; MassGIS (Bike Trails, Tracks and Trails), March 7, 2013; MassGIS (Community Boundaries), March 5, 2013; MassGIS (DEP Wetlands), March 8, 2013; NPS (Park Boundary), March 8, 2013; NPS (Streets and Trails), March 8, 2013; MassGIS (Building Footprints), March 7, 2013

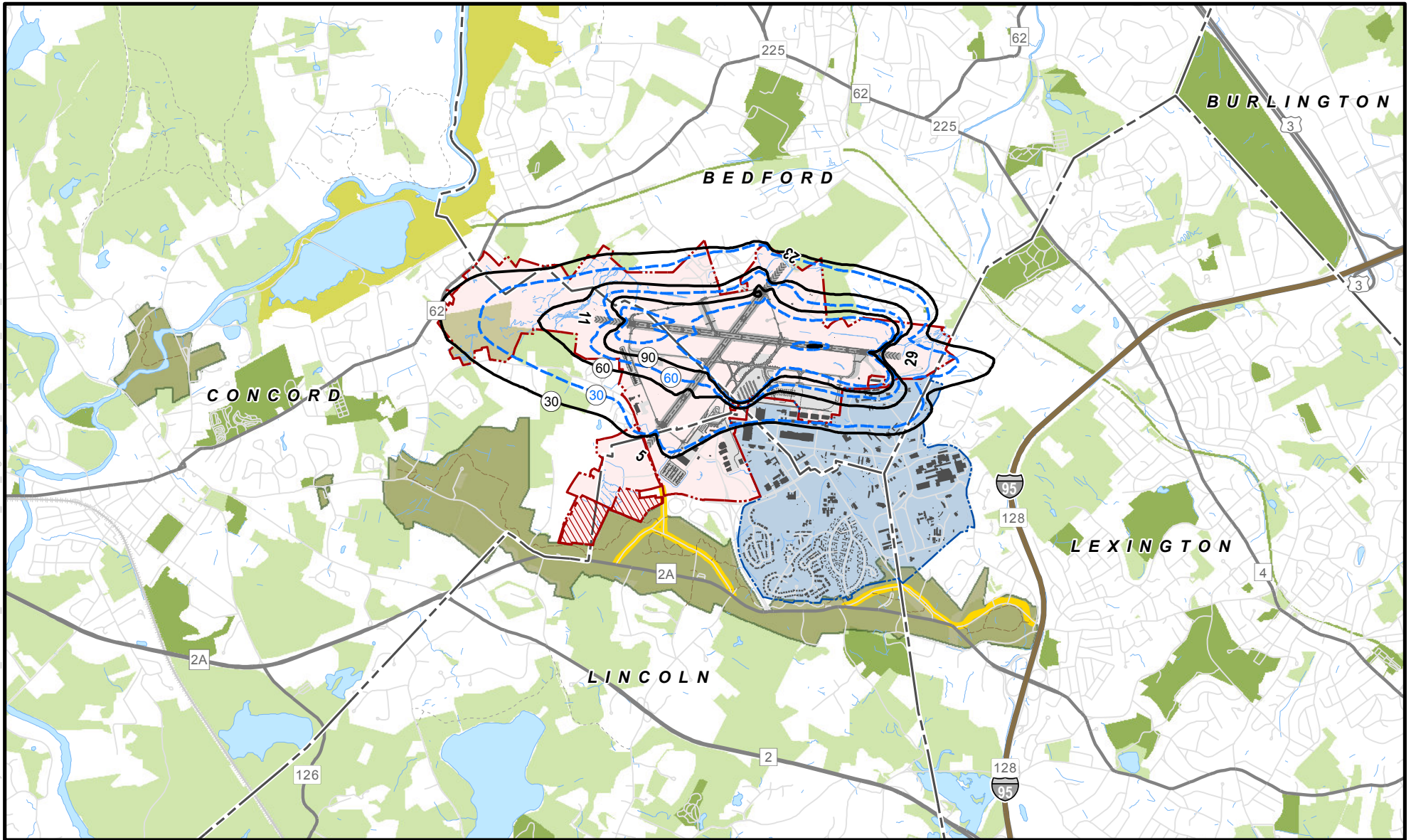


Hanscom Field 2012 ESPR

Bedford, Concord, Lexington, Lincoln, Massachusetts

2012 and 2020 Forecast Time Above 65 dBA Contour Comparison

Figure 7-19



- | | | | | | |
|--|---|--|---------------------|--|------------------------------------|
| | 2030 Time Above 65 dBA Contours (Minutes) | | Historic Road | | MMNHP Boundary |
| | 2012 Time Above 65 dBA Contours (Minutes) | | Interstate | | Great Meadows |
| | Hanscom Field Property Boundary | | Highway | | Open Space Non-protected |
| | Massport Property within MMNHP Congressional Boundary | | Road | | Open Space Protected in Perpetuity |
| | Hanscom AFB Property Boundary | | Trail | | Open Water |
| | Municipal Boundary | | Active Rail Service | | Stream |



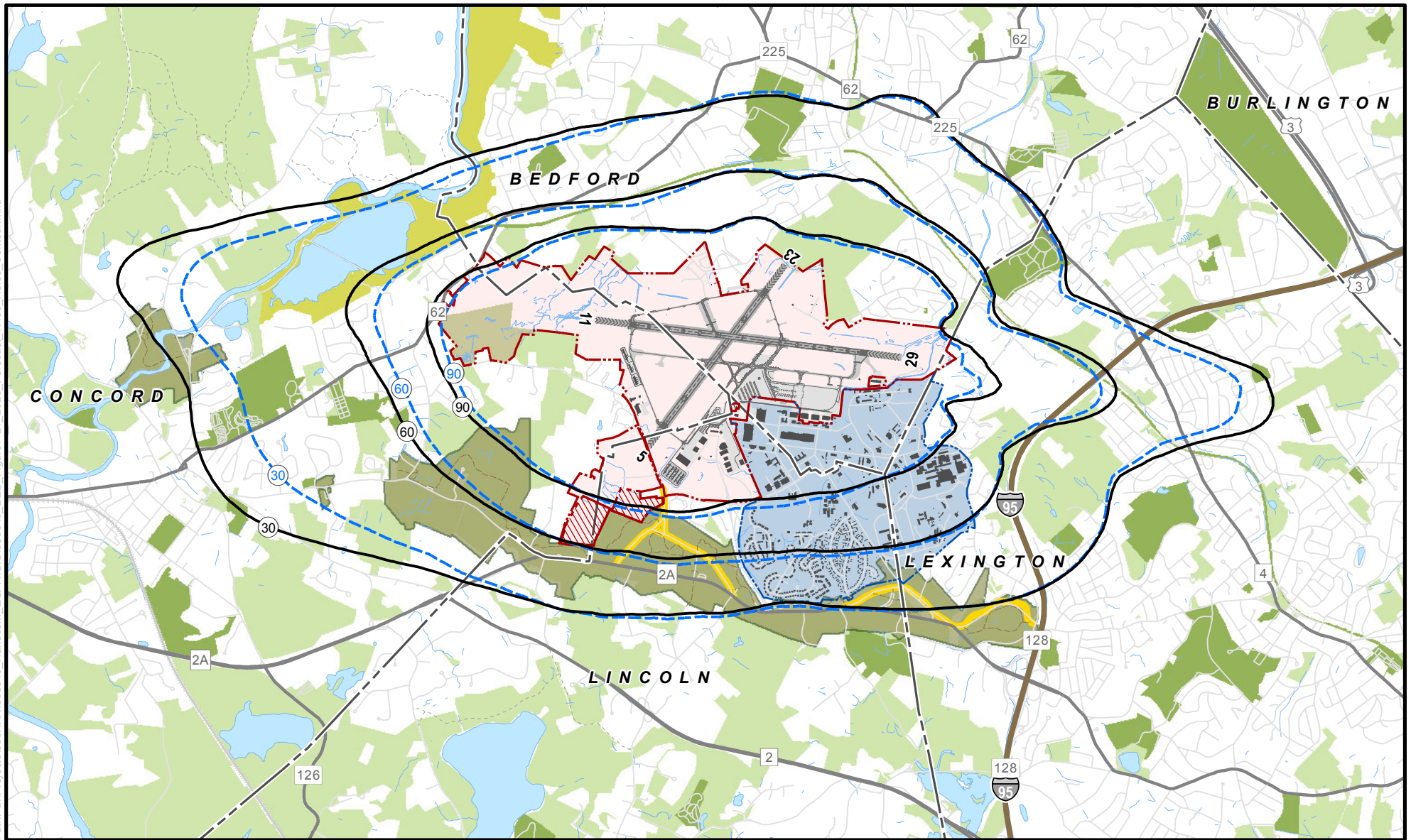
Hanscom Field 2012 ESPR

Bedford, Concord, Lexington, Lincoln, Massachusetts

2012 and 2030 Forecast Time Above 65 dBA Contour Comparison

Figure 7-20

Data Sources: MassGIS (Roads, Rail), March 5, 2013; MassGIS (Bike Trails, Tracks and Trails), March 7, 2013; MassGIS (Community Boundaries), March 5, 2013; MassGIS (DEP Wetlands), March 8, 2013; NPS (Park Boundary), March 8, 2013; NPS (Streets and Trails), March 8, 2013; MassGIS (Building Footprints), March 7, 2013



- | | | | | | |
|--|---|--|---------------------|--|------------------------------------|
| | 2020 Time Above 55 dBA Contours (Minutes) | | Historic Road | | MMNHP Boundary |
| | 2012 Time Above 55 dBA Contours (Minutes) | | Interstate | | Great Meadows |
| | Hanscom Field Property Boundary | | Highway | | Open Space Non-protected |
| | Massport Property within MMNHP Congressional Boundary | | Road | | Open Space Protected in Perpetuity |
| | Hanscom AFB Property Boundary | | Trail | | Open Water |
| | Municipal Boundary | | Active Rail Service | | Stream |

Data Sources: MassGIS (Roads, Rail), March 5, 2013; MassGIS (Bike Trails, Tracks and Trails), March 7, 2013; MassGIS (Community Boundaries), March 5, 2013; MassGIS (DEP Wetlands), March 8, 2013; NPS (Park Boundary), March 8, 2013; NPS (Streets and Trails), March 8, 2013; MassGIS (Building Footprints), March 7, 2013

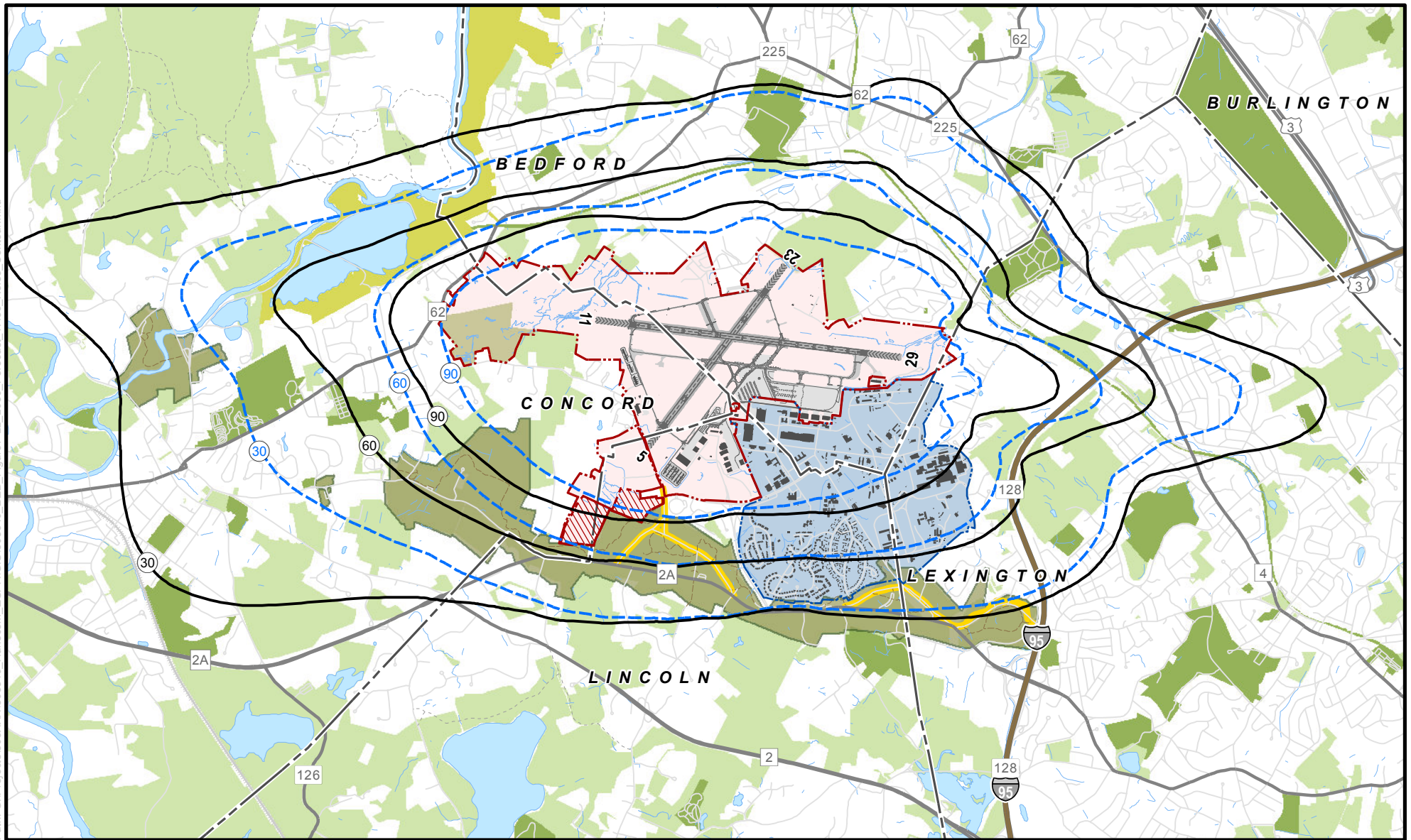


Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

**2012 and 2020 Forecast
Time Above 55 dBA Contour
Comparison**

Figure 7-21

Path: G:\Projects\3055XX\305540_Hanscom_ESPR\GIS\305540_BED_Figure7-22_2030_Forecast TA55_Noise Contour.mxd



- | | | | | | |
|--|--|--|---------------------|--|------------------------------------|
| | 2030 Time Above 55 dBA Contour | | Historic Road | | MNHP Boundary |
| | 2012 Time Above 55 dBA Contour | | Interstate | | Great Meadows |
| | Hanscom Field Property Boundary | | Highway | | Open Space Non-protected |
| | Massport Property within MNHP Congressional Boundary | | Road | | Open Space Protected in Perpetuity |
| | Hanscom AFB Property Boundary | | Trail | | Open Water |
| | Municipal Boundary | | Active Rail Service | | Stream |



Hanscom Field 2012 ESPR

Bedford, Concord, Lexington, Lincoln, Massachusetts

2030 Forecast Time Above 55 dBA Contour

Data Sources: MassGIS (Roads, Rail), March 5, 2013; MassGIS (Bike Trails, Tracks and Trails), March 7, 2013; MassGIS (Community Boundaries), March 5, 2013; MassGIS (DEP Wetlands), March 8, 2013; NPS (Park Boundary), March 8, 2013; NPS (Streets and Trails), March 8, 2013; MassGIS (Building Footprints), March 7, 2013

Figure 7-22

No federal or other criteria exist for judging the relevance of these reported numbers. Both the acreage and the selected TA contour levels serve primarily as a secondary means of helping to judge the change in noise environment that is expected under the forecast scenarios.

Table 7-30 Areas within Time Above 65 and 55 dBA Contours for Existing and Forecast Operations

Contour Level	Cumulative Area (Acres)			
	2005	2012	2020	2030
Time Above 65 dBA				
90 minutes	281	289	325	408
60 minutes	498	526	555	692
30 minutes	1,326	1,238	1,302	1,529
Time Above 55 dBA				
90 minutes	1,828	2,362	2,449	3,055
60 minutes	3,551	4,006	4,159	4,940
30 minutes	8,405	7,542	8,175	9,794

Table 7-31 Population within Time Above 65 and 55 dBA Contours for Existing and Forecast Operations

Contour Level	Population between Time Above Contours			
	2005	2012	2020	2030
Time Above 65 dBA				
90 Minutes or Greater	0	0	0	21
60 to 90 Minutes	50	52	74	119
30 to 60 Minutes	470	349	366	440
Total 30 Minutes or Greater	520	401	440	580
Time Above 55 dBA				
90 Minutes or Greater	937	1,139	1,216	1,965
60 to 90 Minutes	1,301	2,610	2,691	3,016
30 to 60 Minutes	9,112	6,234	7,208	9,064
Total 30 Minutes or Greater	11,350	9,983	11,115	14,045

7.6.5 Total Noise Exposure (EXP)

The operations forecasts were also analyzed to compute EXP values. Table 7-32 summarizes the results. The primary means of tracking the metric is through civil air departures, highlighted in bold in the table. As expected, the EXP computations show the same trends as the DNL forecasts. Compared to 2012, the component attributable to civil departures is projected to increase for both the 2020 and 2030 forecasts from 107.4 dB in 2012 and to 107.6 in 2020 and 108.7 dB in 2030, respectively. These are broadly indicative of the change in DNL values among the various scenarios, consistent with the original reason for developing EXP in the first place.

Table 7-32 Year 2012 Total Noise Exposure (EXP) for Existing and Forecast Operations (in dB)

Groups	Departure Only	Arrival Only	Total
2012			
All civil aircraft except single piston	106.2	106.6	109.5
All civil aircraft ¹	107.4	108.0	110.7
All military aircraft	91.3	87.8	92.9
All civil and military aircraft except single piston	106.3	106.6	109.5
All civil and military aircraft	107.5	108.0	110.8
2020			
All civil aircraft except single piston	106.5	107.4	110.0
All civil aircraft ¹	107.6	108.6	111.1
All military aircraft	93.9	90.7	95.6
All civil and military aircraft except single piston	106.7	107.5	110.1
All civil and military aircraft	107.8	108.6	111.2
2030			
All civil aircraft except single piston	107.8	108.5	111.2
All civil aircraft ¹	108.7	109.5	112.1
All military aircraft	93.9	90.7	95.6
All civil and military aircraft except single piston	108.0	108.6	111.3
All civil and military aircraft	108.8	109.6	112.2
Note:			
1. Civil air departures, which are the primary means of tracking EXP, are highlighted in bold.			

Source: HMMH

7.6.6 Distribution of Noise Events

Figure 7-23 shows the forecasted distribution of daily departure SELs for each of the two future scenarios with the values for 2012 shown for comparison. As with the historical data, single engine piston operations are excluded for the clarity of the figure. The figure illustrates the changes in fleet mix over time: the greatest growth is forecasted for operations in the 80 to 85 dBA categories while operations in the noisiest groups (greater than 95 dB) are generally very small in number and are expected to remain small or decrease over time. The noise increases are the result of increased operations overall but particularly for GA aircraft.

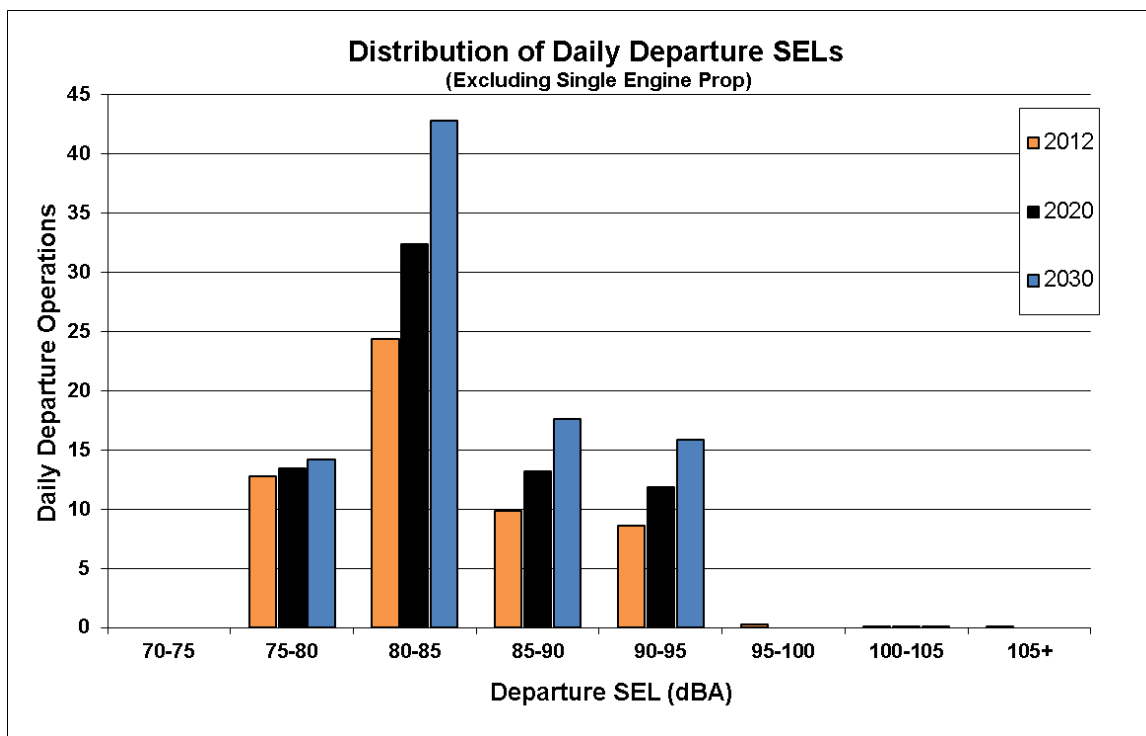


Figure 7-23 Existing and Forecast Distribution of Daily Departure SELs (Excluding Single Engine Prop)

7.6.7 DNL for Existing and Forecast Years at Noise Analysis Locations in Minute Man National Historical Park

Table 7-33 presents computed DNL at locations within the Minute Man National Historical Park for the two future scenarios with 2012 included for comparison. In the future scenarios all locations within the Park are exposed to levels below 55 dB DNL.

No part of the 4.9-mile Battle Road Interpretive Trail is located within the 65 dB DNL contour for year 2012 or either of the forecast scenarios. None of the Battle Road Interpretive Trail is in the 55 dB DNL contour in year 2012 or either of the forecast scenarios.

Table 7-34 and Table 7-35 present the results of the Time Above 65 dBA and Time Above 55 dBA computations for sites within Minute Man National Historical Park. Current TA 65 values at the Minute Man National Historical Park are at most eight minutes per day at all sites. These are times when aircraft noise may cause speech disruption or require use of a raised voice. These sites are expected to experience TA 65 for the future scenarios, ranging from one to eight minutes for the 2020 scenario and one to ten minutes per day for the 2030 scenario. The highest times above 65 dBA were in the range of eight to ten minutes per day and occurred at the Wayside Unit and in the western end of the Battle Road Unit at sites near Meriam's Corner and in Lincoln near the Brooks Tavern and houses. These are among the closest sites in the Park to Hanscom Field's runways, and receive noise from several types of aircraft operations including departures turning south off of Runway 29, aircraft departing Runway 23, and pattern operations on Runway 11/29.

Available research data suggest that noticeability of aircraft occurs at the point at which aircraft noise equals or exceeds the ambient levels. Given that daytime ambient levels in many areas in the Minute Man National Historical Park range from high-30s to mid-40s dBA, the Time Above 55 data suggest that these are times when park visitors could notice aircraft. The highest times above 55 dBA were in the range of

63 to 84 minutes per day and occurred at the Historic Farming Fields (MM-10) in Concord and in the area stretching from Bloody Angle to the Sgt. Samuel Hartwell House Site (MM-18).

Table 7-33 DNL at Noise Analysis Locations in the Minute Man National Historical Park for Existing and Forecast Operations (in dB)

Label ¹	Name ²	Unit/Town ³	2012	2020	2030
MM-1	Major John Buttrick House	North Bridge Unit / Concord	48.7	49.1	50.0
MM-2	NPS Headquarters and Visitor Center at 174 Liberty St. (Stedman Buttrick Residence)	North Bridge Unit / Concord	48.3	48.5	49.4
MM-3	North Bridge Comfort Station	North Bridge Unit / Concord	48.2	48.3	49.2
MM-4	The Minuteman (Statue)	North Bridge Unit / Concord	47.9	47.8	48.8
MM-5	North Bridge	North Bridge Unit / Concord	48.0	48.0	49.0
MM-6	Old Manse *	North Bridge Unit / Concord	48.1	48.1	49.2
MM-7	The Wayside (Samuel Whitney House) *	Wayside Unit / Concord	50.3	50.6	51.8
MM-8	Meriam's Corner Monument	Battle Road Unit / Concord	50.3	50.7	51.8
MM-9	Meriam House	Battle Road Unit / Concord	50.6	51.1	52.2
MM-10	Historic Farming Fields	Battle Road Unit / Concord	50.7	51.0	52.0
MM-11	Olive Stow House/Farwell Jones House/Carty Barn	Battle Road Unit / Concord	49.2	49.4	50.3
MM-12	Samuel Brooks House	Battle Road Unit / Concord	50.8	51.3	52.1
MM-13	Noah Brooks Tavern (and Carriage House)	Battle Road Unit / Lincoln	51.4	52.0	52.8
MM-14	Job Brooks House	Battle Road Unit / Lincoln	51.5	52.0	52.8
MM-15	Joshua Brooks, Jr. House	Battle Road Unit / Lincoln	50.7	51.2	52.0
MM-16	Bloody Angle	Battle Road Unit / Lincoln	50.9	51.0	51.6
MM-17	Ephraim Hartwell Tavern	Battle Road Unit / Lincoln	49.2	49.1	49.6
MM-18	Sgt. Samuel Hartwell House Site	Battle Road Unit / Lincoln	48.5	48.3	48.8
MM-19	Captain William Smith House	Battle Road Unit / Lincoln	47.0	46.8	47.4
MM-20	Paul Revere Capture Site and Marker	Battle Road Unit / Lincoln	45.8	45.8	46.4
MM-21	Mile Three Location (Approximate)	Battle Road Unit / Lincoln	45.5	45.4	46.0
MM-22	John Nelson House and Barn	Battle Road Unit / Lincoln	46.0	46.0	46.7
MM-23	Josiah Nelson, Jr. House Foundation	Battle Road Unit / Lincoln	47.0	47.0	47.7
MM-24	Thomas Nelson, Jr. House Foundation	Battle Road Unit / Lincoln	47.1	47.1	47.9
MM-25	Parkers Revenge	Battle Road Unit / Lexington	47.0	47.1	47.8
MM-26	Minute Man Visitor Center	Battle Road Unit / Lexington	46.1	46.2	47.0
MM-27	Jacob Whittemore House	Battle Road Unit / Lexington	46.4	46.5	47.4
MM-28	The Bluff and Monument	Battle Road Unit / Lexington	45.9	46.2	47.1
MM-29	Mile Four Location (Approximate)	Battle Road Unit / Lexington	46.2	46.4	47.3
MM-30	Ebenezer Fiske House Foundation	Battle Road Unit / Lexington	46.2	46.7	47.8
MM-31	Col. James Barrett Farm*	Barrett Farm Unit/Concord	43.5	43.9	44.9

Notes:

1. The Minute Man National Historical Park is a national historic landmark district. All sites are in the National Register of Historic Places.
2. Sites within Minute Man National Historical Park are marked with an asterisk (*) if they are individually listed in the National Register of Historic Places.
3. Sites in the Battle Road Unit are located on the Battle Road Interpretive Trail. MM-21 and MM-29 do not refer to specific historic resources, but provide additional coverage of sites along the Trail. MM-21 is approximately three miles east of Meriam's Corner and MM-29 is approximately four miles east of Meriam's Corner.

Table 7-34 Time-Above 65 dBA at Noise Analysis Locations in the Minute Man National Historical Park for Existing and Forecast Operations (in minutes)

Label ¹	Name ²	Unit/Town ³	2012	2020	2030
MM-1	Major John Buttrick House	North Bridge Unit / Concord	3.1	3.9	5.0
MM-2	NPS Headquarters and Visitor Center at 174 Liberty St. (Stedman Buttrick Residence)	North Bridge Unit / Concord	2.8	3.5	4.5
MM-3	North Bridge Comfort Station	North Bridge Unit / Concord	2.7	3.4	4.4
MM-4	The Minuteman (Statue)	North Bridge Unit / Concord	2.5	3.2	4.2
MM-5	North Bridge	North Bridge Unit / Concord	2.7	3.4	4.4
MM-6	Old Manse *	North Bridge Unit / Concord	2.9	3.7	4.8
MM-7	The Wayside (Samuel Whitney House) *	Wayside Unit / Concord	5.7	7.1	9.3
MM-8	Meriam's Corner Monument	Battle Road Unit / Concord	5.7	6.8	8.8
MM-9	Meriam House	Battle Road Unit / Concord	6.2	7.4	9.5
MM-10	Historic Farming Fields	Battle Road Unit / Concord	7.0	7.9	9.5
MM-11	Olive Stow House/Farwell Jones House/Carty Barn	Battle Road Unit / Concord	4.7	5.0	5.8
MM-12	Samuel Brooks House	Battle Road Unit / Concord	6.6	6.7	7.6
MM-13	Noah Brooks Tavern (and Carriage House)	Battle Road Unit / Lincoln	7.3	7.3	8.4
MM-14	Job Brooks House	Battle Road Unit / Lincoln	8.0	8.0	9.0
MM-15	Joshua Brooks, Jr. House	Battle Road Unit / Lincoln	7.1	7.1	8.1
MM-16	Bloody Angle	Battle Road Unit / Lincoln	7.3	7.2	8.1
MM-17	Ephraim Hartwell Tavern	Battle Road Unit / Lincoln	4.1	4.0	4.3
MM-18	Sgt. Samuel Hartwell House Site	Battle Road Unit / Lincoln	2.9	2.8	3.0
MM-19	Captain William Smith House	Battle Road Unit / Lincoln	1.5	1.5	1.6
MM-20	Paul Revere Capture Site and Marker	Battle Road Unit / Lincoln	1.1	1.1	1.2
MM-21	Mile Three Location (Approximate)	Battle Road Unit / Lincoln	1.0	1.0	1.1
MM-22	John Nelson House and Barn	Battle Road Unit / Lincoln	1.3	1.3	1.4
MM-23	Josiah Nelson, Jr. House Foundation	Battle Road Unit / Lincoln	1.8	1.8	2.0
MM-24	Thomas Nelson, Jr. House Foundation	Battle Road Unit / Lincoln	1.9	1.9	2.1
MM-25	Parkers Revenge	Battle Road Unit / Lexington	1.9	1.9	2.2
MM-26	Minute Man Visitor Center	Battle Road Unit / Lexington	1.4	1.5	1.7
MM-27	Jacob Whittemore House	Battle Road Unit / Lexington	1.6	1.7	2.0
MM-28	The Bluff and Monument	Battle Road Unit / Lexington	1.5	1.7	2.1
MM-29	Mile Four Location (Approximate)	Battle Road Unit / Lexington	1.6	1.7	2.0
MM-30	Ebenezer Fiske House Foundation	Battle Road Unit / Lexington	2.0	2.4	3.1
MM-31	Col. James Barrett Farm*	Barrett Farm Unit/Concord	0.7	0.9	1.2

Notes:

1. The Minute Man National Historical Park is a national historic landmark district. All sites are in the National Register of Historic Places.
2. Sites within Minute Man National Historical Park are marked with an asterisk (*) if they are individually listed in the National Register of Historic Places.
3. Sites in the Battle Road Unit are located on the Battle Road Interpretive Trail. MM-21 and MM-29 do not refer to specific historic resources, but provide additional coverage of sites along the Trail. MM-21 is approximately three miles east of Meriam's Corner and MM-29 is approximately four miles east of Meriam's Corner.

Table 7-35 Time-Above 55 dBA at Noise Analysis Locations in the Minute Man National Historical Park for Existing and Forecast Operations (in minutes)

Label ¹	Name ²	Unit/Town ³	2012	2020	2030
MM-1	Major John Buttrick House	North Bridge Unit / Concord	26.6	31.5	39.8
MM-2	NPS Headquarters and Visitor Center at 174 Liberty St. (Stedman Buttrick Residence)	North Bridge Unit / Concord	26.1	31.0	39.0
MM-3	North Bridge Comfort Station	North Bridge Unit / Concord	25.8	30.6	38.6
MM-4	The Minuteman (Statue)	North Bridge Unit / Concord	25.1	29.7	37.4
MM-5	North Bridge	North Bridge Unit / Concord	25.8	30.5	38.4
MM-6	Old Manse *	North Bridge Unit / Concord	26.3	31.0	39.0
MM-7	The Wayside (Samuel Whitney House) *	Wayside Unit / Concord	34.4	39.6	49.2
MM-8	Meriam's Corner Monument	Battle Road Unit / Concord	47.0	52.0	63.1
MM-9	Meriam House	Battle Road Unit / Concord	51.0	56.0	67.8
MM-10	Historic Farming Fields	Battle Road Unit / Concord	77.2	80.6	94.5
MM-11	Olive Stow House/Farwell Jones House/Carty Barn	Battle Road Unit / Concord	57.1	59.6	69.9
MM-12	Samuel Brooks House	Battle Road Unit / Concord	52.3	52.7	60.3
MM-13	Noah Brooks Tavern (and Carriage House)	Battle Road Unit / Lincoln	51.1	50.8	57.4
MM-14	Job Brooks House	Battle Road Unit / Lincoln	57.2	56.5	63.5
MM-15	Joshua Brooks, Jr. House	Battle Road Unit / Lincoln	53.2	52.3	58.6
MM-16	Bloody Angle	Battle Road Unit / Lincoln	84.4	80.7	88.7
MM-17	Ephraim Hartwell Tavern	Battle Road Unit / Lincoln	72.5	67.9	73.6
MM-18	Sgt. Samuel Hartwell House Site	Battle Road Unit / Lincoln	63.5	59.2	64.0
MM-19	Captain William Smith House	Battle Road Unit / Lincoln	45.7	42.7	46.1
MM-20	Paul Revere Capture Site and Marker	Battle Road Unit / Lincoln	31.0	29.6	32.7
MM-21	Mile Three Location (Approximate)	Battle Road Unit / Lincoln	25.9	24.6	27.0
MM-22	John Nelson House and Barn	Battle Road Unit / Lincoln	32.7	31.7	35.6
MM-23	Josiah Nelson, Jr. House Foundation	Battle Road Unit / Lincoln	42.6	41.4	46.3
MM-24	Thomas Nelson, Jr. House Foundation	Battle Road Unit / Lincoln	43.1	42.0	47.0
MM-25	Parkers Revenge	Battle Road Unit / Lexington	41.1	40.2	45.2
MM-26	Minute Man Visitor Center	Battle Road Unit / Lexington	31.3	30.9	35.0
MM-27	Jacob Whittemore House	Battle Road Unit / Lexington	32.5	32.2	36.6
MM-28	The Bluff and Monument	Battle Road Unit / Lexington	24.4	24.8	28.5
MM-29	Mile Four Location (Approximate)	Battle Road Unit / Lexington	29.7	29.7	33.8
MM-30	Ebenezer Fiske House Foundation	Battle Road Unit / Lexington	19.8	20.6	24.3
MM-31	Col. James Barrett Farm*	Barrett Farm Unit/Concord	11.9	14.0	17.4

Notes:

1. The Minute Man National Historical Park is a national historic landmark district. All sites are in the National Register of Historic Places.
2. Sites within Minute Man National Historical Park are marked with an asterisk (*) if they are individually listed in the National Register of Historic Places.
3. Sites in the Battle Road Unit are located on the Battle Road Interpretive Trail. MM-21 and MM-29 do not refer to specific historic resources, but provide additional coverage of sites along the Trail. MM-21 is approximately three miles east of Meriam's Corner and MM-29 is approximately four miles east of Meriam's Corner.

7.7 Status of Hanscom Field Noise Workgroup Recommendations

Following the filing of the 1995 GEIR in 1997, the Secretary of Environmental Affairs asked Massport to organize and meet with a community and aviation-based workgroup for six months. The committee, known as the Hanscom Field Noise Workgroup, met for a period of two years, and published its findings in a report entitled "Report of the Hanscom Field Noise Workgroup," dated September 22, 1999. Its report summarizes the series of meetings by the committee and its two task groups, one devoted to abatement and mitigation, the other to metrics and modeling. Together, the two task groups developed a comprehensive list of recommendations that are presented in Table 7-36 and Table 7-37.

Massport has responded to all of the metric recommendations as indicated in Table 7-36. Nearly ninety percent of the recommendations have been implemented or are in the process of implementation. Eight of the fourteen measures were included in the *2005 ESPR* and updated in the *2012 ESPR*. Four other recommendations related to noise monitoring and the correlation of complaints with noise events are being addressed through updates to the Noise and Operations Monitoring System.

Table 7-37 includes a list of recommended noise abatement actions; Massport was primarily responsible for implementing a number of these recommendations. Table 7-37 presents the entire list from the Hanscom Field Noise Work Group report (using the same numbering methodology). All of the recommendations for which Massport was responsible for implementing have been addressed.

7.8 Existing Environmentally Beneficial Measures

In addition to the measures included in Table 7-36 and 7-37, Massport has a long history of noise abatement at Hanscom Field, dating back to at least 1978, when it introduced measures to minimize noise. These measures were officially adopted as a Massport regulations in 1980³⁸ and included restrictions on operations on touch-and-go training activity; and nighttime field use surcharge to discourage operations between 11:00 p.m. and 7:00 a.m. More recently, Massport has implemented measures to monitor and reduce noise in the communities near Hanscom Field. These include guidelines for run-ups and the use of Auxiliary and Ground Power Units, a Noise and Operations Monitoring system, a Fly Friendly program, and membership in Sound Initiative. In 2009, Massport made some adjustments to the touch-and-go flight tracks which reduced the amount of direct flights over the MMNHP and nearby residences. A brochure describing the changes was jointly released by Massport and the NPS and is distributed to pilots and the public directly and through Massport's website.

³⁸ Part F of the General Rules and Regulations for Laurence G. Hanscom Field Effective July 31, 1980.

Table 7-36 Hanscom Noise Workgroup Metrics Recommendations

Number	Description	Status
M1	The workgroup should continue in existence and make additional suggestions for changes to the ESPR.	The Noise Workgroup contributed substantially to the formulation of the scope of work that formed the basis for the ongoing Hanscom Field ESPR analyses.
M2	The ESPR should include Time-Above (TA) contours and their areas.	Included. Figure 7-12, Figure 7-13 and Figure 7-19 to Figure 7-22 illustrate the contours and Table 7-16 and Table 7-30 present the estimated areas within the contours.
M3	The ESPR should show Single Event Level Distributions.	Included as Figure 7-16 and Figure 7-23.
M4	The next GEIR [ESPR] should include a linear dimensionless metric to show exposure to noise energy.	Not included. No such metric is used regularly in the evaluation of aircraft or other environmental noise.
M5	Future GEIRs (ESPRs) should include discussion of impacts with reference to the EPA level of 55 dB DNL and avoid the implication that DNL less than 65 (the Federal Aviation Administration mitigation threshold) has no impact.	Included.
M6	Future GEIRs (ESPRs) should include three Community Summary Metrics - Loud Event Count, Area of 55 dB DNL contour, and Area of the 30- minute TA 55 dBA contour.	Included. Figure 7-16 and Figure 7-23 present SEL distributions; Table 7-9 and Table 7-24 present the estimated areas within the DNL contours; Table 7-11 and Table 7-25 present the population estimates within the current and forecasted 55 dB DNL contour; Figure 7-13, Figure 7-21 and Figure 7-22 present the area of the 30-minute TA 55 dBA contour
M7	Documentation should include a detailed list of assumptions and model parameters used in the noise modeling.	Included.
M8	The ESPR should include a section discussing the estimated variation in Integrated Noise Model (INM) results due to different modeling assumptions, and Massport should adopt the standard practice of reporting "error bands." The ESPR should also include a comparison of measured and modeled results and an explanation of the differences.	Not included. The noise analyses in the ESPR are intended to evaluate the range of noise exposure due to existing and forecast fleet and airport development assumptions. Measured noise values are compared to modeled noise values for the six permanent noise monitors.
M9	Future ESPRs should explain expected short-term variations in noise from long-term averages.	Included.
M10	The ESPR should document how changes in the INM data [base] affect predicted noise exposure.	Included.
M11 and M12	Three of the six permanent noise monitoring sites should be relocated and more sites should be added to the system.	Following an incident in 2009 in which a vehicle struck the Site 34 noise monitor on DeAngelo Drive in Bedford, Massport relocated the monitor nearby and further off of the road. Massport is evaluating the feasibility of relocating Site 36.
M13 and M14	A procedure or system should be developed to correlate noise events with flight data and complaints, and the noise data should be stored in a publicly accessed location such as a web site.	Recent updates to the Noise and Operations Monitoring System are described in Section 7.8.4.

Table 7-37 Status of the Hanscom Noise Workgroup Noise Abatement Recommendations

Number	Measure	Detail	Massport Actions to Date
A1	Voluntary Noise Abatement Procedures	Massport will formalize, publish, distribute and post existing noise abatement procedures drafted by Massport, HART, and HPA.	Massport distributed handouts and posters describing noise abatement procedures to all tenants, fixed base operators, and flight training schools. Massport mailed AOPA Fly Friendly videos to all hangar and tie-down tenants. Additionally, Massport installed AOPA and NBAA noise abatement procedures in its badge training program. All based pilots are required to watch the AOPA or NBAA video when getting or renewing a security badge. The program has been in place for about 6 years.
A2	Distribution to Renters	Massport will duplicate and deliver to flights schools voluntary noise abatement procedures in sufficient quantity for schools to distribute to all aircraft renters.	Massport distributes handouts and posters describing noise abatement procedures to all tenants, fixed based operators, and flight training schools.
A3	Informative Page Markers	Massport will print and distribute informative page markers for noise abatement information in Jeppesen and Flight guide handbooks to local and transient pilots.	Massport distributes flight manual inserts describing noise abatement procedures to all tenants, fixed base operators, and flight training schools.
A4	Flight School Briefings	Hanscom flight schools will display and distribute local noise abatement procedures to their pilots, brief all flight instructors at least annually on local noise abatement procedures and AOPA Fly Friendly program, and require all students to view the AOPA Fly Friendly video.	Massport discusses noise abatement with the flight schools and makes the AOPA Fly Friendly video available. Handouts are replenished. Flight school pilots and student pilots watch the AOPA video when getting or renewing a security badge.
A5	Flight Training Center Briefings	The Hanscom AFB Flight Training Center will display in its flight planning room, and distribute to its members local noise abatement procedures brief the AOPA Fly Friendly program and local noise abatement procedures at its safety meetings at least annually, and require new club members to view the AOPA Fly Friendly video.	Massport provided the Hanscom AFB Flight Training Center with posters, flight manual inserts, and AOPA Fly Friendly videos. Flight manual inserts continue to be made available.
A6	FBO Guest Follow-up	Each FBO at Hanscom will institute a guest sign-in sheet and send each transient pilot a follow-up letter describing the voluntary noise abatement procedures at Hanscom.	Massport works with FBOs to implement this measure. Massport makes inserts available which the FBOs display in their flight preparation rooms.
A7	Massport Website	Massport will include the voluntary noise abatement procedures for Hanscom on its public access website with mutual links to the USAF and other web-based pre-flight planning resources.	Massport's website includes the voluntary noise abatement procedures for Hanscom Field. The "Activity Monitor" has also been added to the website which allows the public to research a noise event or flight, log a noise disturbance, and track correspondence related to a noise disturbance.
A8	ATIS Broadcast	The Automatic Terminal Information System (ATIS) broadcast will include a reminder that voluntary noise abatement procedures are in effect and whenever workload permits the Tower, Ground, and Clearance Delivery will follow with reminders.	Massport is not the primary entity responsible for implementing this measure. The ATIS is managed by the FAA.
A9	Hanscom AFB Leader Briefings	Hanscom AFB representatives to the Hanscom Noise Workgroup will brief Electronic Systems Center and 66th Air Base Wing leaders on local noise abatement procedures, sensitivities, and issues.	Massport is not the primary entity responsible for implementing this measure. However, Massport will provide Hanscom AFB with information as needed to support this measure.
A10	Military Flight Crews	Hanscom AFB Transient Alert will display and distribute local noise abatement procedures and information to military flight crews utilizing their facility.	Massport is not the primary entity responsible for implementing this measure. Massport distributed handouts and posters describing noise abatement procedures and continues to make handouts available.

Number	Measure	Detail	Massport Actions to Date
A11	ESC Web page	The Hanscom AFB Electronic Systems Center will create a web page dealing with noise abatement issues at Massport for both military and civilian pilots.	Massport is not the primary entity responsible for implementing this measure. However, Massport will provide Hanscom AFB with information as needed to support this measure.
A12	ESC Press Releases	The Hanscom AFB Electronic Systems Center Office of Public Affairs will send area newspapers regular (biweekly or monthly) news releases updating area residents on Air Force flight operations, subject to security considerations.	Massport is not the primary entity responsible for implementing this measure. However, Massport will provide Hanscom AFB with information as needed to support this measure.
A13	ESC Website News Releases	The Hanscom AFB Electronic Systems Center Office of Public Affairs will add information about Air Force flight operations to the public access section of the Hanscom AFB web site, subject to security considerations.	Massport is not the primary entity responsible for implementing this measure. However, Massport will provide Hanscom AFB with information as needed to support this measure.
A14	AOPA Video Distribution	Massport will purchase and distribute the AOPA Fly Friendly video to all Hanscom pilots.	Massport distributed the video to all tenants, fixed based operators, and flight training schools. Pilots are required to watch the AOPA or NBAA video when getting or renewing a security badge. This program has been in place for the past six years.
A15	Hanscom User Group	Massport will provide support to ensure that a representative user group be available to all users, pilots, and businesses.	Massport is supportive of aviation user groups and encourages aviation participation at HFAC.
A16	Selectmen and Town Briefings	HNWG will brief Town Selectmen on the group's findings.	Massport is not the primary entity responsible for implementing this measure. However, Massport will provide the HNWG with information as needed to support this measure.
A17	Part 150 Study	A group representing local pilots, business interests, surrounding communities and Massport will be formed to investigate the possibility and implications of re-opening the Part 150 Study at Hanscom Field.	Massport is not the primary entity responsible for implementing this measure. Massport does not believe a Part 150 study is warranted or advisable. However, it will provide information to the group as needed to support the responsible evaluation of this measure.
A18	Model Quiet Airport Study	A group representing local pilots, business interests, surrounding communities and Massport will be formed to define the scope and purpose of a Model Quiet Airport Study at Hanscom Field.	Massport is not the primary entity responsible for implementing this measure. However, it will provide information to the group as needed to support the responsible evaluation of this measure.
A19	Non-Profit Organization	A group representing local pilots, business interests, surrounding communities and Massport will be formed to explore the idea of establishing a non-profit organization to raise funds to support various noise reduction awareness programs.	Massport is not the primary entity responsible for implementing this measure. However, it will provide information to the group as needed to support the responsible evaluation of this measure.
A20	Noise Abatement Officer	A group representing local pilots, business interests, surrounding communities and Massport will be formed to explore the idea of establishing a Noise Abatement Officer position at Hanscom Field.	Massport has a Noise Abatement Coordinator who ensures continued distribution of noise abatement materials, talks to pilots, and responds to comments concerning noise. In addition, Massport's Office of Noise Abatement (at Logan) supports Hanscom's noise monitoring system.
A21	Noise Overlay Zones	A group including representatives of the Planning Boards of the towns of Lincoln, Lexington, Bedford, and Concord will be formed to study the issues associated with the creation of Noise Overlay Zoning Districts.	Massport is not the primary entity responsible for implementing this measure. However, it will provide information to the group as needed to support the responsible evaluation of this measure.
There are a number of recommendations for which Massport is not the primary entity responsible.			

7.8.1 Run-up Procedures

Massport has a well-defined aircraft engine maintenance run-up procedure for Hanscom Field. Aircraft are directed to the "Run-up Pad" located due south of Runway 11-29, west of the intersection with Runway 05-23. At the Run-up Pad, aircraft are directed to maintain a west heading when conducting run-ups; there is a short "blast fence" on the east side of the pad which deflects jet exhaust, prop wash, and debris. Furthermore, Massport discourages operators from conducting nighttime run-ups.

After Shuttle America began performing regular aircraft maintenance at Hanscom Field, there were times when nighttime run-ups occurred for maintenance purposes. After receiving multiple complaints, mostly from residents in newly constructed homes along Virginia Road, Massport re-located those nighttime run-ups to the east end of the East Ramp, away from this residential community. Shuttle America has since discontinued service to Hanscom Field, and subsequently there have been no regular nighttime maintenance run-ups at Hanscom.

Massport will continue to direct operators to the run-up pad during the day and to the East Ramp at night should extenuating circumstances require such activities. The optimal orientation for run-ups at the East Ramp is a magnetic heading of approximately 230 degrees, aligned with Runway 05-23, whenever feasible based on wind conditions. This heading will minimize sound levels at homes north of the approach end of Runway 11-29, while providing a substantial reduction in sound levels at the newly constructed homes along Virginia Road, relative to levels during run-ups conducted at the run-up pad. This heading is desirable for use regardless of aircraft type, though jet aircraft are likely to be more sensitive to crosswind conditions and may not be able to use the preferred heading as often as propeller aircraft can.

7.8.2 Auxiliary Power Units and Ground Power Units

Massport has additional ground noise procedures in effect minimizing the use of on-board Auxiliary Power Units (APUs) and Ground Power Units (GPUs). APUs and GPUs provide electricity, heat and air conditioning to an aircraft when its engines are off.

At Hanscom Field, APU and GPU use is prohibited outside of hangars between 11:00 p.m. and 7:00 a.m. unless part of takeoff procedures or necessary maintenance procedures. Between 7:00 a.m. and 11:00 p.m., the use of APUs is limited to 30 minutes.

When operationally feasible, the use of GPUs is preferred over APUs. Although the noise levels produced by GPUs are not insignificant (they are similar to an idling diesel truck), they are considerably lower than the noise levels produced by a typical APU. In addition, GPUs generally are more fuel efficient than APUs and less expensive to run from a maintenance standpoint. Reduction of APU use may also have the benefit of reducing emissions. It should be noted that it is not feasible to completely eliminate APU use because APUs may be needed to start the aircraft main engines, and maintenance requiring operation of the APU may sometimes need to be performed at locations where alternative power is not readily available.

7.8.3 Field Use Fee

Although the FAA control tower is closed from 11:00 p.m. to 7:00 a.m., Hanscom Field is a public facility and is open for use 24 hours a day. In the summer of 1980, an 11:00 p.m. to 7:00 a.m. "nighttime field use fee" was a surcharge instituted to discourage the use of the field between 11:00 p.m. and 7:00 a.m. The fee is based on aircraft weight and doubles for aircraft that conduct more than five night

operations in a calendar year. In 1980 the surcharge were \$20 for aircraft weighing 12,500 pounds or fewer and \$150 for aircraft weighing more than 12,500 pounds.

In 1989, the Massport Board voted to increase the surcharge to reflect the Consumer Price Index (CPI) increase between 1980 and 1989 and to institute an annual CPI increase, effective each July 1. This schedule coincides with Massport's Fiscal Years, which run from July 1st to June 30th annually. As a result, the surcharges were \$55 and \$401 for the first six months of 2012 and \$56 and \$412 for the second half of 2012.

Some operations are exempted from the fee. The overwhelming majority of exemptions are medical flights, which are dominated by the medical evacuation service based at Hanscom. Exemptions also included military, FAA, and Civil Air Patrol operations, as well as Hanscom based aircraft that used the airport between 11 p.m. and 7 a.m. due to unavoidable circumstances, such as weather, mechanical, or FAA delays.

7.8.4 Noise and Operations Monitoring System

Massport's current Noise and Operations Monitoring System (NOMS) was installed in 1989. It includes six permanent noise monitors near Hanscom Field. In 2004, Massport selected Rannoch Corporation, now ITT Exelis Corporation, to replace the system's microphones and software. The replacement NOMS incorporates state-of-the-art capabilities that have improved the accuracy, efficiency, usefulness, reliability, and user-friendliness of the system.

Hanscom staff members began experiencing the benefits of the new system in 2007 and have been able to provide callers with more information about disturbing flights than had been available in the past. An interactive website has been developed for public use³⁹. This website includes:

- Complaint entry
- Near-real-time⁴⁰ and historical aircraft flight tracks
- Customized reports for any time period for DNL, hourly Leq, and noise events at the permanent noise monitors

In April of 2009, the Site 34 monitor on DeAngelo Drive in Bedford was hit by a vehicle, which caused substantial damage. Because a tree that had grown near the site could potentially contaminate data and because there had been similar incidents in prior years, Massport determined that a new location needed to be identified for installing a replacement. This led to a review of possible locations, which included discussions with Bedford representatives and taking noise measurements and analyzing flight tracks at numerous alternative sites. It was determined that DeAngelo Drive was the best acoustical location, which led to selecting a site that was close to the old site but away from trees and set back from the road. This work was completed in 2010.

7.8.5 Fly Friendly Program

Massport first developed a fly friendly program in 2001. This program encourages pilots to use the quietest flying techniques that are safe and practical. Inserts for pilot manuals continue to be made available for pilots of all aircraft (including commercial aircraft), outlining the Aircraft Owners and Pilot Association's and National Business Aircraft Association's quiet flying recommendations. Framed

³⁹<http://www.massport.com/hanscomfield/Overview/Airport-Activity-Monitor/>

⁴⁰ Flight track data is delayed by ten minutes for security purposes.

posters describing noise abatement procedures are hanging in the flight school offices and FBOs. Massport also periodically reminds these offices to encourage the pilots to use quiet flying techniques including through quarterly meetings. More details on the Fly Friendly Program are provided in Section 7.5.6.

7.8.6 Sound Initiative

Massport was an active participant in Sound Initiative, a coalition that supported the federal phase out of Stage 2 aircraft weighing less than 75,000 pounds. Stage 2 aircraft were manufactured before today's stringent noise standards were adopted for new airplanes. The use of Stage 2 aircraft weighing over 75,000 pounds was phased out nationally by 2000, but most of Hanscom's jets weigh less than 75,000 pounds. In 2012, Congress passed the FAA Modernization and Reform Act, which included the phase out of all non-stage 3 aircraft by December 31, 2015. Section 506 of the Act prohibits the operation, within the 48 contiguous states, of jets weighing 75,000 pounds or less that do not comply with Stage 3 noise levels. Military aircraft are exempt from the Stage 3 Rule.

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8 Air Quality

This chapter of the *2012 ESPR* describes year 2012 and projected future air quality and air emissions in the study area. The *2012 ESPR* future scenarios are used to evaluate the potential cumulative environmental effects that could occur if Hanscom Field reaches the airport activity levels that are described in Chapter 3, Airport Activity Levels. The 2020 and 2030 growth scenarios represent estimates of what could occur (not what will occur) in the future using certain planning assumptions and are not necessarily recommended outcomes.

8.1 Key Findings Since 2005

Up to 25 years of Massachusetts Department of Environmental Protection (MassDEP) air monitoring data for the Greater Boston area were used to evaluate air quality trends for years up to and including the year 2012. These data reveal that:

- Air quality in the Greater Boston area, including the Hanscom communities, has improved substantially over the past 25 years and has improved since the *2005 ESPR* was published.
- The Greater Boston area, including the Hanscom Field communities, is currently in attainment with all Massachusetts and National Ambient Air Quality Standards (NAAQS) except for the 1997 8-hour ozone NAAQS which was designated as moderate non-attainment by the EPA.
- Ozone levels for the Boston area, including the Hanscom Field community were designated as attainment/unclassifiable with the new 2008 eight-hour ozone standard by U.S. EPA.⁴¹

Annual emissions from aircraft operations and motor vehicles accessing the airport were calculated for the year 2012. These emissions were compared to emissions for 1985, 1995, 2000 and 2005 which were previously presented in the *2005 ESPR*. These emission calculations demonstrate that emissions associated with Hanscom Field activity are a very small fraction of regional emissions. Aircraft emissions for all pollutants decreased between 2005 and 2012; these changes are a result of the changes in the mix of aircraft operating at Hanscom Field as well as a reduction in the number of operations. Roadway emissions for all pollutants declined between 2005 and 2012 due to the effects of more stringent emission controls on motor vehicles. The emission levels for the future scenarios are not predicted to result in adverse air quality effects near or away from the airport. For all scenarios, air quality concentrations in Bedford, Concord, Lexington, Lincoln, Minute Man National Historical Park and Great Meadows National Wildlife Refuge will be in compliance with the Massachusetts and National Ambient Air Quality Standards.

8.2 Air Quality Terminology

The Clean Air Act (CAA) contains timeframes and milestones for states to meet and maintain National Ambient Air Quality Standards (NAAQS) for criteria pollutants. EPA sets NAAQS at levels to protect

⁴¹EPA recently implemented the 2008 eight-hour ozone NAAQS where EPA designated Middlesex County as attainment/unclassifiable in April of 2012.

public health and the environment. MassDEP is the state agency responsible for monitoring outdoor air quality in Massachusetts and developing plans and regulatory programs to reduce emissions of pollutants that adversely affect public health, welfare, and the environment.

8.2.1 Air Pollutants

Certain pollutants (known as “criteria” pollutants) are subject to National Ambient Air Quality Standards (NAAQS). The criteria pollutants monitored are:

- sulfur dioxide (SO₂): SO₂ combines with water vapor to form acidic aerosols harmful to the respiratory tract, aggravating symptoms associated with lung diseases such as asthma and bronchitis. SO₂ is a primary contributor to acid deposition. Impacts of acid deposition include: acidification of lakes and streams, damage to vegetation, damage to materials, and diminution of visibility. SO₂ is a product of fuel combustion (e.g., the burning of coal and oil that contains sulfur). Sources include power plants, and business and residential sources burning heating oil.
- ozone (O₃): Ground-level, or Tropospheric O₃ and Stratospheric O₃ in the upper atmosphere are the same chemical compound, just found at different places in the atmosphere. Stratospheric O₃ found at greater than 30,000 feet above the surface of the earth is beneficial to all life because it filters out the sun’s harmful UV radiation before it reaches the earth’s surface. Ground-Level O₃ on the other hand is a health and environmental problem. This report pertains exclusively to ground-level O₃. O₃ is a respiratory irritant and can reduce lung function and cause asthma attacks, nasal congestion, and throat irritation, and reduce resistance to infection. It can inflame and damage (possibly permanently) cells that line the lungs, and aggravate chronic lung diseases. In addition, a number of studies have found a strong link between increases in ground-level O₃ and increased risk of premature death. O₃ is toxic to vegetation, inhibiting growth and causing leaf damage. O₃ deteriorates materials such as rubber and fabrics. Ground-level O₃ is unique in that it is formed by the reactions that occur between certain pollutants in the presence of intense, high-energy sunlight during the hot summer months. The complexity of the reactions and the amount of time needed to complete these reactions can result in the buildup of ground-level ozone concentrations far downwind from the original source of the precursors. Sources of ground-level O₃ precursors, i.e., nitrogen oxides and hydrocarbons, include motor vehicles, lawn and garden equipment, power plants and other industrial sources.
- carbon monoxide (CO): CO binds with hemoglobin in the blood, reducing the amount of oxygen carried to organs and tissues. Symptoms of high CO exposure include shortness of breath, chest pain, headaches, confusion, and loss of coordination. The health threat is most severe for those with cardiovascular disease. Motor vehicle emissions are the largest source of CO, which is produced from incomplete combustion of carbon in fuels. Industrial processes and non-transportation fuel combustion (e.g., boilers, lawn and garden equipment) also are sources of CO.
- nitrogen dioxide (NO₂): NO₂ lowers resistance to respiratory infections and aggravates symptoms associated with asthma and bronchitis. NO₂ contributes to acid deposition. Impacts of acid deposition include: acidification of lakes and streams, damage to vegetation, damage to materials, and diminution of visibility. NO₂ and NO contribute to the formation of ozone. NO₂ is formed from the oxidation of nitric oxide (NO). Major sources of NO are fuel combustion, space heating, power plants and motor vehicles.
- lead (Pb): Lead is an elemental metal that is found in nature. Exposure to lead can occur by inhalation or ingestion with food, water, soil or dust particles. Children, infants, and fetuses are the most susceptible to the effects of lead exposure. Lead causes mental retardation, brain damage,

and liver disease. It may be a factor in high blood pressure and damages the nervous system. Lead enters the atmosphere from the incineration of lead containing materials and from the manufacture and processing of lead containing products or materials like storage batteries, smelting and removal of paint that contained lead.

- particulate matter ≤ 10 microns (PM_{10}) and ≤ 2.5 microns ($PM_{2.5}$): Particulate matter is tiny airborne particles or aerosols, which include dust, dirt, soot, smoke, and liquid droplets. Fine particulate matter (mostly below 2.5 microns in size) are not only the result of direct emissions, but can be formed in the atmosphere by chemical reactions involving gaseous pollutants. The numbers 2.5 and 10 refer to the particle size, measured in microns, collected by the monitors. For example, several thousand $PM_{2.5}$ particles could fit on the period at the end of this sentence. The small size of these particles allows easy entry into the human respiratory system. Long-term exposure causes the particles to accumulate in the lungs and affects breathing and produces respiratory symptoms. The small particles can migrate through the lungs and into the circulatory system and potentially produce cardio-vascular symptoms, as well as impacts from toxic components contained in the particulate matter. Particulate matter causes soiling and corrosion of materials. Particulate matter contributes to atmospheric haze that degrades visibility. Sources of particulates include industrial process emissions, motor vehicles, incinerators, power plants, and other fuel combustion sources.

Non-criteria pollutants do not have National Ambient Air Quality Standards, but can contribute to the formation of ozone and particulate matter and/or be toxic. The non-criteria pollutants monitored by MassDEP include: total suspended particulates (TSP), and air toxics which include certain volatile organic compounds (VOCs), a precursor to ozone, and toxic metals.

8.2.2 Air Quality Standards

Five principal air pollutants are emitted by aircraft: carbon monoxide (CO), volatile organic compounds (VOC), nitrogen oxides (NO_x), particulate matter (PM_{10}), and fine particulate matter ($PM_{2.5}$).

Massachusetts and National Ambient Air Quality Standards (NAAQS) exist for CO, sulfur dioxide (SO_2), PM_{10} , $PM_{2.5}$, lead, and nitrogen dioxide (NO_2), one of the NO_x compounds. There are no standards for VOC, which is regulated as a precursor to ozone (O_3), for which an air quality standard has been established. Aircraft also emit carbon dioxide (CO_2), which is not classified by EPA as an air pollutant under the NAAQS, however EPA asserts that carbon dioxide and five other greenhouse gases from both stationary and mobile sources pose a threat to human health. The EPA also found that GHG emissions from on-road vehicles contribute to that threat.

Table 8-1 Annual Frequency of Wind Speed, Wind Direction and Atmospheric Stability Observed at Hanscom Field

Wind Speed (knots) ¹	Percent		Wind Direction	Percent
<1	22.3%		N	3.9%
1-4	7.9%		NNE	3.4%
4-7	27.0%		NE	4.1%
7-11	26.8%		ENE	2.8%
11-17	14.5%		E	2.7%
17-21	1.2%		ESE	2.4%
>22	0.3%		SE	1.9%
			SSE	1.8%
			S	3.5%
			SSW	6.2%
			SW	8.8%
			WSW	8.2%
			W	8.1%
			WNW	7.9%
			NW	6.9%
			NNW	4.9%
Note: 1. Approximate speed ranges. Actual categories are based on knots, not mph.				

Source: MassDEP AERMOD Surface Meteorological Files, Station #14702, Hanscom Field, Bedford, Mass., (2005-2009).

The U.S. EPA has established air quality standards for outdoor (ambient) air to protect the public's health and welfare with a margin for safety. The NAAQS are summarized in Table 8-2. Concentration units for the NAAQS shown in Table 8-2 are given in parts per million (ppm) and micrograms of pollutant per cubic meter of air ($\mu\text{g}/\text{m}^3$). The one-hour value for NO_2 is a MassDEP policy guideline (not a regulatory standard) that is only applicable to major stationary sources emitting over 250 tons per year of NO_2 . Although it is not applicable to Hanscom Field in a regulatory sense (since airports are not stationary sources), Massport has used the guideline value in the past in other airport air quality assessments, and so its use is continued in the 2012 *ESPR*. It should be noted the new federal 1-hour NO_2 NAAQS is applicable to Hanscom and was included in the compliance of modeling concentrations with standards in Section 8.2.13.

Since 2005, the EPA has established new standards as well as strengthened existing standards. The 24-hour $\text{PM}_{2.5}$ standard was strengthened in September 2006 from $65 \mu\text{g}/\text{m}^3$ to $35 \mu\text{g}/\text{m}^3$ and the annual $\text{PM}_{2.5}$ standard was strengthened to $12 \mu\text{g}/\text{m}^3$ along with the 3-month lead standard which was strengthened to $0.15 \mu\text{g}/\text{m}^3$. EPA has established a new eight-hour ozone standard of 0.075 ppm, a new one-hour NO_2 standard of 100 ppb, and a new one-hour SO_2 standard of 75 ppb. The primary annual and 24-hour SO_2 standards were revoked in June of 2010 along with the annual PM_{10} standard in October of 2006.

Air quality in Bedford, Concord, Lexington, and Lincoln is very good and is in compliance with all existing NAAQS as classified by the EPA⁴² except the 1997 eight-hour ozone standard. While ozone levels remain in compliance with the new eight-hour standard, a few exceedances of the eight-hour NAAQS have been measured at the Stow and Chelmsford monitors. Ozone concentrations in Eastern Massachusetts are greatly affected by air pollution transport from the New York/New Jersey/Connecticut metropolitan area, and these changes are likely influenced by conditions to the west.

⁴²40 CFR 81.322

Table 8-2 Massachusetts and National Ambient Air Quality Standards (NAAQS)

Pollutant	Averaging Time	Primary Standards	Secondary Standards	MAAQS Standard
CO	8-Hour ¹	9 ppm (10 mg/m ³)	None	9 ppm (10 mg/m ³)
	1-Hour ¹	35 ppm (40 mg/m ³)	None	35 ppm (40 mg/m ³)
NO ₂	Annual	0.053 ppm (100 ug/m ³)	Same as Primary	100 ug/m ³
	1-Hour ²	0.1 ppm (188 ug/m ³)	None	320 ug/m ³
PM ₁₀	Annual ³	None	None	50 ug/m ³
	24-Hour ¹	150 ug/m ³	Same as Primary	150 ug/m ³
PM _{2.5}	Annual ⁴	12 ug/m ³	15 ug/m ³	None
	24-Hour ⁵	35 ug/m ³	Same as Primary	None
SO ₂	Annual	None	None	80 ug/m ³
	24-Hour ¹	None	None	365 ug/m ³
	3-Hour ¹	None	0.5 ppm (1,300 ug/m ³)	0.5 ppm (1,300 ug/m ³)
	1-Hour	75 ppb (196 ug/m ³)	None	None
Lead	Rolling 3-Month Average	0.15 ug/m ³	Same as Primary	1.5 ug/m ³
Ozone	8-Hour ⁶ (2008 Standard)	0.075 ppm	Same as Primary	None
	8-Hour (1997 Standard)	0.08 ppm	Same as Primary	None
	1-Hour ⁷	None	None	235 ug/m ³ (0.12 ppm)

Notes:
1. Not to be exceeded more than once a year.
2. MassDEP NO₂ Policy Guideline level not to be exceeded more than one day per year.
3. The annual PM₁₀ standard was revoked nationwide in 2006.
4. Three-year average of annual PM_{2.5} arithmetic means.
5. Three-year average of 98th percentile 24-hour PM_{2.5} concentrations.
6. Three-year average of annual 4th highest daily maximum 8-hour ozone concentration.
7. The 1-hour ozone standard was revoked for most areas nationwide in 2005.

Source: 40 CFR 50, 310 CMR 6.0

8.3 Year 2012 Conditions

The sections that follow provide climate data, discuss ambient air quality standards and present air quality data for Hanscom Field. Emission inventories for the year 2012 have been developed for both aircraft operations and vehicular traffic.

8.3.1 Climate

The climate for Hanscom Field is determined in part by its proximity to the Atlantic Ocean. Lying 16 miles inland and at an elevation of approximately 130 feet above mean sea level, wind patterns at Hanscom Field are different from those in Boston, including a greater occurrence of calm winds, which are characteristic of inland locations. On a large scale, Hanscom Field is subject to the rapid weather changes typical to southern New England. The largest storms move up the east coast from the Carolinas and in most cases pass to the south and east of the area, resulting in northeast and east winds with rain, snow, and fog. Annual winds are predominantly from the west, with winter winds from the northwest and summer winds from the southwest. Determinant factors include:

- **Wind direction** - determines where emissions will travel as they are diluted and dispersed in the atmosphere.
- **Wind speed** - determines the dilution rate, with higher speeds resulting in greater dilution and lower air pollutant concentrations.
- **Atmospheric stability** - determines the rate at which pollutants released near the ground are mixed and dispersed in the atmosphere, with a neutral to unstable atmosphere providing rapid dispersion and a stable atmosphere providing slower dispersion. Stable conditions occur, by

definition, only at night when there is no solar heating of the ground to produce thermal air turbulence.

The annual frequency of wind speed and direction at Hanscom Field are summarized in Table 8-1. These data are based on a five-year climatological average of hourly measurements taken at Hanscom Field from 2005 to 2009.

8.3.2 Historical Air Quality Monitoring Data

MassDEP monitoring data were used to conservatively estimate existing background air quality levels in the Hanscom Field communities. Historical records from these same stations were used to provide a perspective on how air quality in the region today compares with that in the recent past. For the purposes of the *2012 ESPR*, MassDEP monitoring data were used to estimate existing background air quality concentrations and then form total concentrations (Hanscom Field effects plus background levels) for comparison with air quality standards. Following EPA guidance,⁴³ background concentrations were determined using monitoring data from regional state monitoring sites that have collected over a year of continuous measurements

Site-specific monitoring to establish background air quality levels is generally not done for air quality impact studies and was not done for this *2012 ESPR*. Instead, MassDEP monitoring stations were selected to ensure that the monitoring data are conservative for this purpose, i.e. the levels are higher than existing concentrations in the Hanscom Field communities. This approach was approved by both the MassDEP and the Secretary of Energy and Environmental Affairs as part of the scoping process for this *2012 ESPR*. Conservative monitoring data from state monitoring stations in the project region (e.g., Kenmore Square) are normally used to establish existing background air quality. Since the background data are chosen to be conservatively elevated, their use in forming total predicted concentrations, which are then compared to air quality standards, serves to protect public health with an added margin of safety.

8.3.3 DEP Monitoring Data

As required by MEPA, the appropriateness of MassDEP's monitoring data from the Greater Boston area for use as background levels in the *ESPR* air quality analysis was confirmed. A review of MassDEP monitoring records showed a more than ample selection of available monitoring data from the region that could conservatively represent air quality background levels. The MassDEP Division of Air Quality Control was contacted when the *1995 GEIR* was being prepared and the selected monitoring data were reviewed with MassDEP staff to ensure that they were conservative for the Hanscom Field communities; MassDEP replied that the selected monitoring data were both conservative and acceptable for use in the *1995 GEIR*.⁴⁴ The Hanscom Field community consultants for the *1995 GEIR* also independently contacted MassDEP and confirmed that MassDEP had approved the use of monitoring data from their stations for background conditions in air quality studies at Hanscom Field, and that MassDEP considered the data selected to be conservative.⁴⁵ The sophisticated monitoring equipment used by MassDEP coupled with rigorous quality assurance and quality control procedures, including EPA audits, ensure that the collected data are consistently accurate.

⁴³U.S. EPA, *Guideline on Air Quality Models (Revised)*, 40 CFR 51, Appendix W, November 9, 2005.

⁴⁴Personal communication, Mr. Charles Mentos, MassDEP Division of Air Quality Control, Boston, July 9 and 30, 1996.

⁴⁵Personal communication, Ms. Elizabeth Racca, Dames & Moore, Boston, August 19, 1996.

Site-specific monitoring for NO₂ was performed for the 1995 GEIR to test the accuracy of the analysis for the 1995 GEIR. This monitoring was not performed to establish background levels in the Hanscom Field communities. Its purpose was to test and confirm the assumption that MassDEP's monitoring data from Boston represented conservative estimates of local Hanscom Field community air quality. The monitoring data demonstrated that NO₂ concentrations close to the airport were safely in compliance with the air quality standard and well below those measured by MassDEP at Kenmore Square. Thus, the Kenmore Square data were proven to be conservative, and the MassDEP did not recommend additional air quality monitoring be performed for the 2000 ESPR.⁴⁶ The air quality analysis for the 2012 ESPR is consistent with this approach approved by MassDEP for the 2000 and 2005 ESPR.

8.3.4 Location of Monitoring Stations

There are no MassDEP monitoring stations in the four Hanscom Field communities. The MassDEP stations selected to represent the Hanscom Field communities are those in the Greater Boston area that have historically had the highest pollution levels and the longest historical records. Monitoring data are presented in this section for the pollutants CO, NO₂, SO₂, PM₁₀, PM_{2.5}, lead, and ozone. No monitoring data for VOC are presented; MassDEP does not perform VOC monitoring on a regular basis because there is no state or national air quality standard for VOC. While some special VOC monitoring programs have been undertaken by MassDEP in the past, these were limited in their scope and duration and are not applicable to the Hanscom Field communities. No monitoring is performed for CO₂, as it is not a regulated air pollutant under the NAAQS. Year 2012 emission inventories of VOC emissions from Hanscom Field aircraft operations and motor vehicular traffic are, however, presented in this chapter.

Table 8-3 Background Air Quality Levels (ug/m3)

Pollutant ¹	Averaging Time	Levels Measured In:			Background Selected
		2010	2011	2012	
CO	8-Hour	1,035	1,380	1,495	1,495
	1-Hour	2,070	1,725	1,035	2,070
NO ₂	Annual	36	38	36	38
	1-Hour	96.8	99.4	92.1	99.4
PM ₁₀	Annual	16	17	16	17
	24-Hour	37	38	28	38
PM _{2.5}	Annual	9.3	9.4	9.0	9.2
	24-Hour	20.7	21.2	22.1	21.3

Note:

1. Data for all pollutants are from Kenmore Square, Boston. Concentrations for 1-hour, 8-hour, and 24-hour averages are annual second-highest values, except for 1-hour NO₂ and 24-hour average PM_{2.5} which are 98th percentile values. Selected PM_{2.5} background values are the three-year averages. For all other pollutants the selected background values are the highest of the value measured in the three year period.

Source: Massachusetts DEP Air Monitoring Reports (<http://www.mass.gov/eea/agencies/massdep/air/quality/air-monitoring-reports-and-studies.html>)

The data for CO, NO₂, PM₁₀, and PM_{2.5}, are from the Kenmore Square monitoring station in Boston.⁴⁷ Data for ozone are from the Chelmsford and Stow⁴⁸ monitors. For all pollutants except ozone, the selected monitor is in the City of Boston where emission densities are higher than in the Hanscom Field

⁴⁶Memorandum. From: Christine Kirby, MassDEP, To: EOEa Secretary Durand, Subject: EOEa NO. 5484/8696 – Review of the Draft Scope for the 2000 Hanscom Field ESPR, November 27, 2001.

⁴⁷Source: Massachusetts DEP Air Monitoring Reports (<http://www.mass.gov/eea/agencies/massdep/air/quality/air-monitoring-reports-and-studies.html>).

⁴⁸These are the closest ozone monitoring stations to Hanscom Field. The Massachusetts DEP discontinued ozone monitoring at the Sudbury location after 1998, and commenced monitoring at the Stow location in 1998 which was discontinued in 2011. Monitoring commenced in 2012 at the EPA Chelmsford location.

communities. Ozone is not directly emitted from any source, and tends to have higher concentrations downwind of large urban areas. An air quality monitoring station near Hanscom Field, operated by the EPA at their Lexington laboratory from 1991 to 1993, measured ozone and recorded levels approximately 10 percent below those in Sudbury/Stow, where MassDEP discontinued conducting ozone monitoring in 2011 and began monitoring at the EPA site in Chelmsford. No violations of the ozone standard were ever recorded at the Lexington monitoring site near Hanscom Field.

8.3.5 Existing Air Quality Concentrations

Background air quality for CO, NO₂, PM₁₀, and PM_{2.5} was determined using measurements from Kenmore Square for the most recent three-year period (2010-2012). These four pollutants are the principal ones emitted by aircraft engines for which air quality standards have been set. The background levels presented in Table 8-3 represent all of the existing air pollution sources (natural and man-made).

Historical records for CO, NO₂, SO₂, PM₁₀, PM_{2.5}, lead, and ozone from the most representative MassDEP monitoring stations are summarized in Figures 8-1 through 8-9. These figures show that large reductions in pollutant emissions and in the levels of air pollution have occurred over the past 25 years. The aggressive efforts undertaken since 1970 by government and industry to reduce air pollution have resulted in cleaner air today for most of the Greater Boston area (defined as the six counties mainly within I-495).

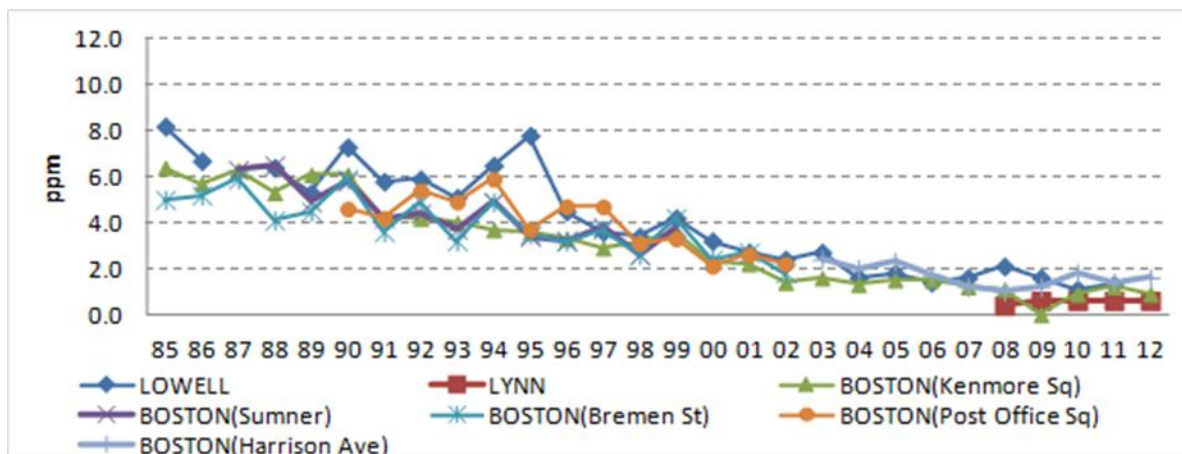


Figure 8-1 8-Hour CO Concentrations Measured at MassDEP Greater Boston Monitors – Kenmore Square and Other Measurement Locations

Source: MassDEP 2012 Annual Air Quality Report

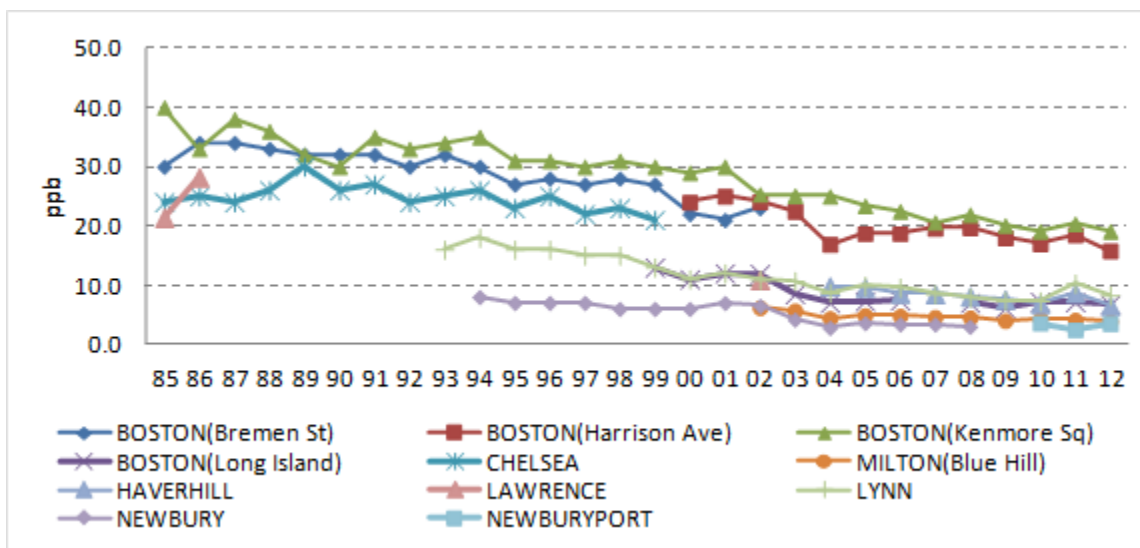


Figure 8-2 Annual NO₂ Concentrations Measured at MassDEP Greater Boston Monitors – Kenmore Square and Other Measurement Locations

Source: MassDEP 2012 Annual Air Quality Report

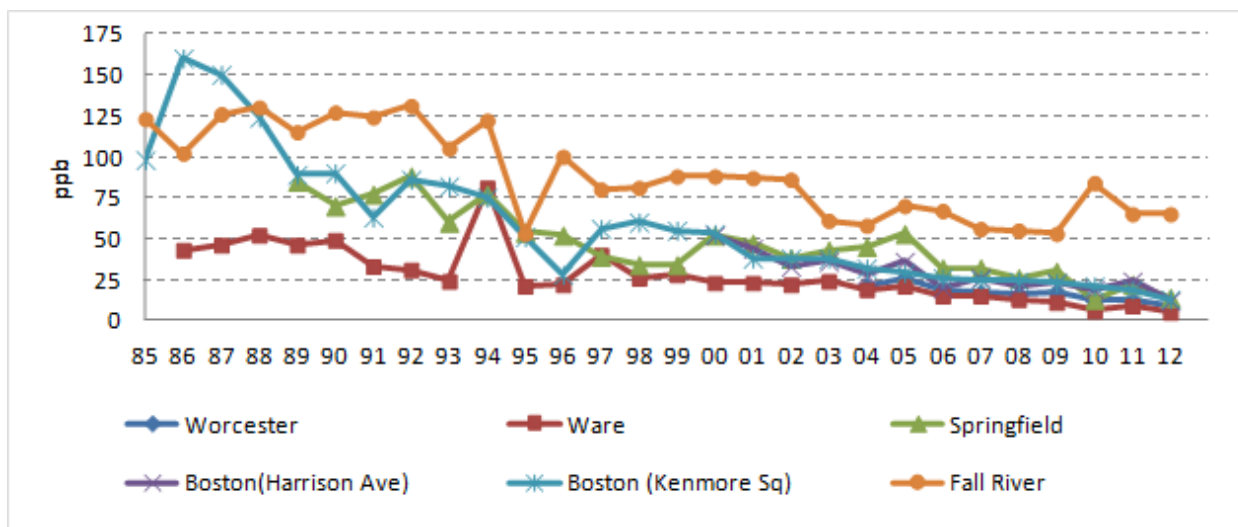


Figure 8-3 1-Hour SO₂ Concentrations Measured at MassDEP Greater Boston Monitors – Kenmore Square and Other Measurement Locations

Source: MassDEP 2012 Annual Air Quality Report

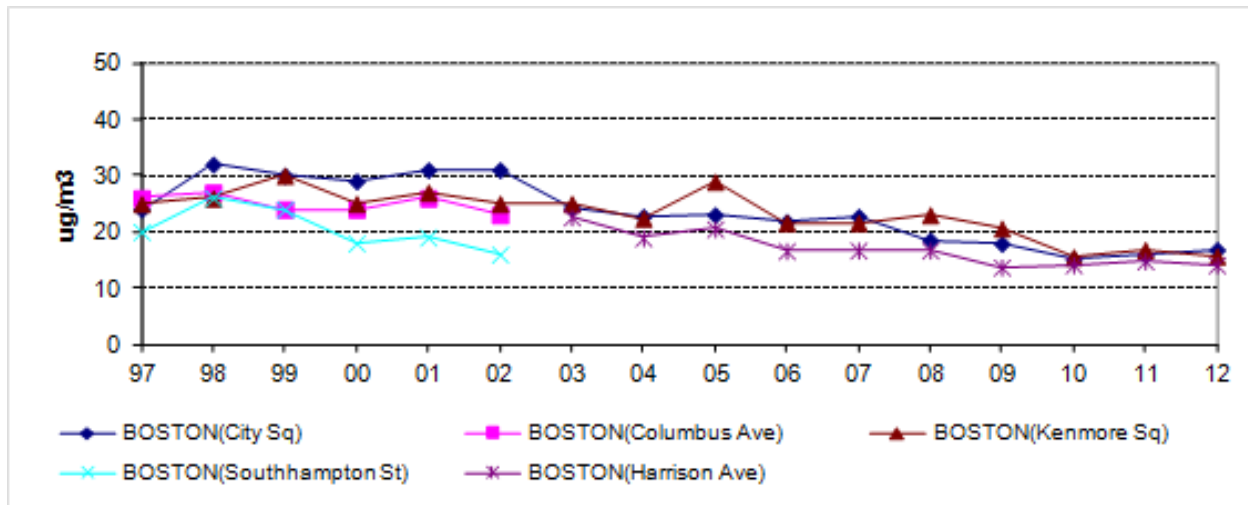


Figure 8-4 Annual PM10 Concentrations Measured at MassDEP Greater Boston Monitors – Kenmore Square and Other Measurement Locations

Source: MassDEP 2012 Annual Air Quality Report

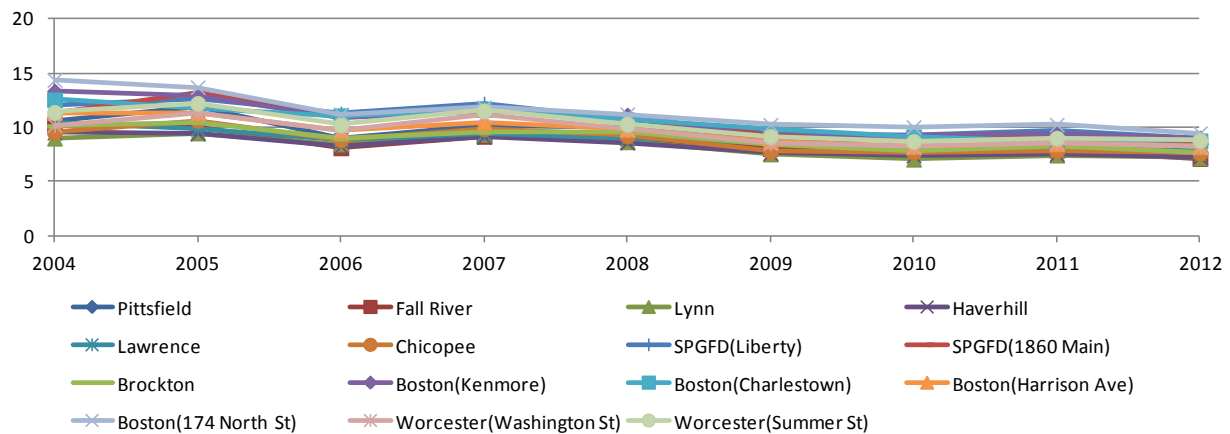


Figure 8-5 Annual PM2.5 Concentrations Measured at MassDEP Greater Boston Monitors – Stow/Kenmore Square and Other Measurement Locations

Source: MassDEP 2012 Annual Air Quality Report

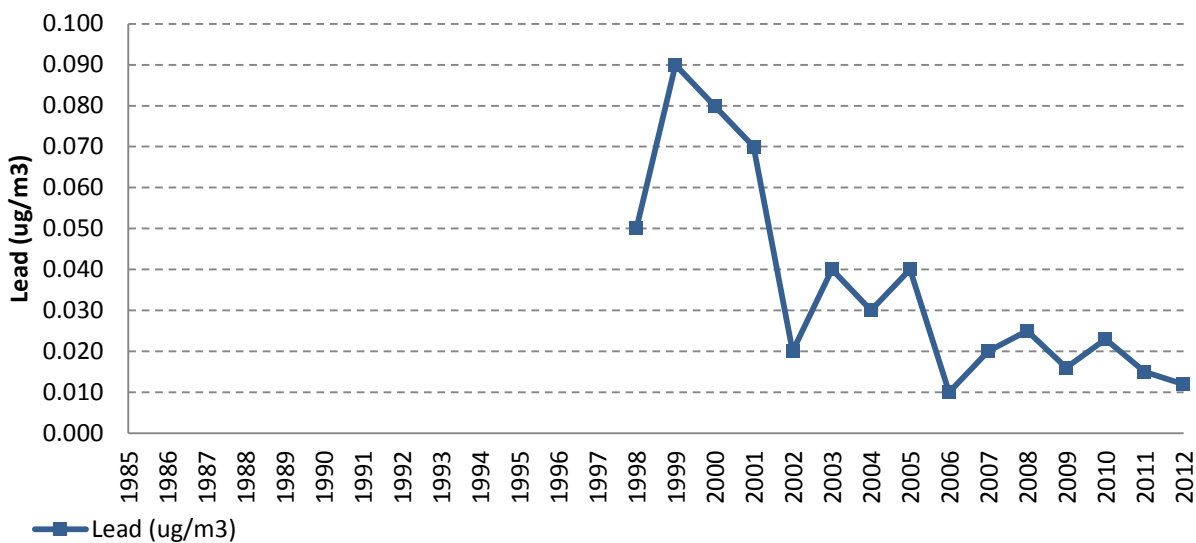


Figure 8-6 Calendar Quarter Lead Concentrations Measured at MassDEP Monitoring Station in Kenmore Square and Harrison Avenue, Boston

Source: MassDEP Annual Air Quality Reports (1998-2012)

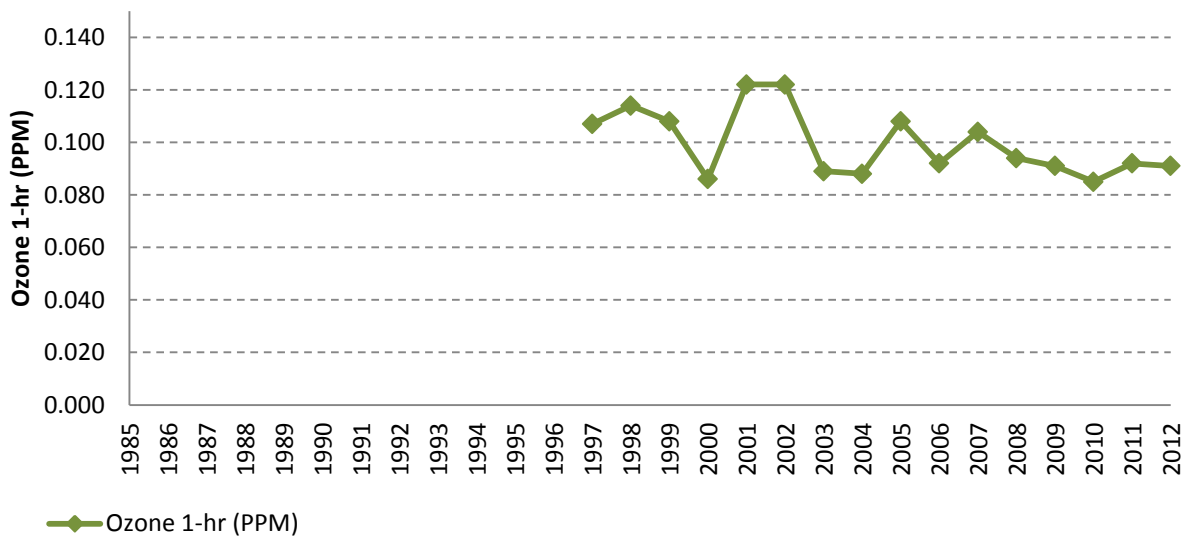


Figure 8-7 1-Hour Ozone Concentrations Measured at MassDEP Greater Boston Monitors – Sudbury/Stow/Chelmsford

Source: MADEP Annual Air Quality Reports (1997-2012)

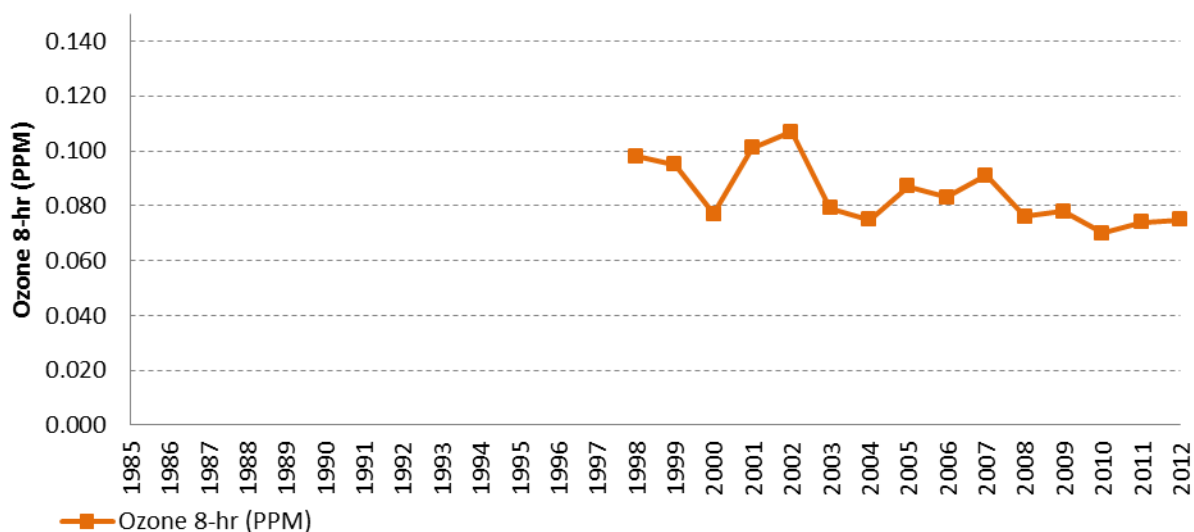


Figure 8-8 8-Hour Ozone Concentrations Measured at MassDEP Greater Boston Monitors – Sudbury/Stow/Chelmsford

Source: MADEP Annual Air Quality Reports (1998-2012)

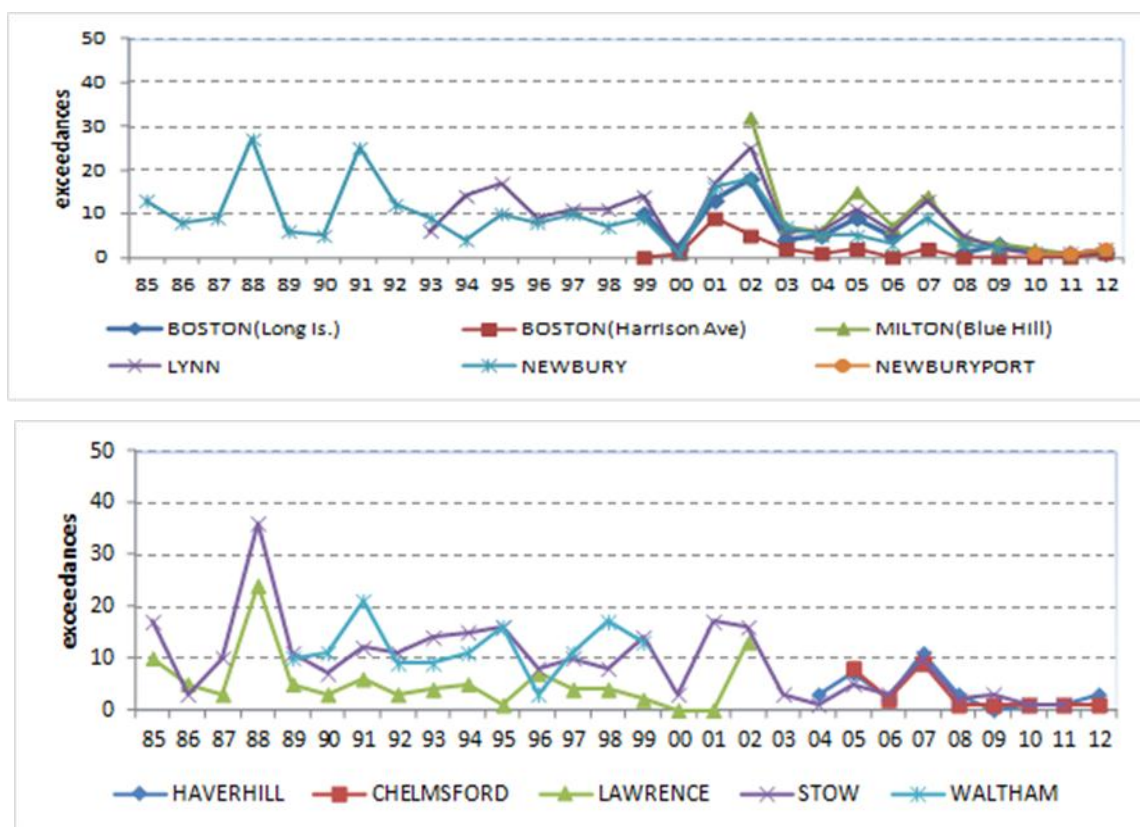


Figure 8-9 Number of Exceedances of 8-Hour Ozone Concentrations Measured at MassDEP Greater Boston Monitors – Sudbury/Stow and Other Measurement Locations

Source: MADEP 2012 Annual Air Quality Report

EPA has established NAAQS for seven major air pollutants to protect public health and welfare with an adequate margin of safety. These standards have been periodically reviewed and updated, as necessary,

over time. The Greater Boston area has had "clean air" (i.e., no violations of the air quality standards for these pollutants) for six of the seven major air pollutants:

- PM₁₀, NO₂, SO₂ and lead for over 25 years
- CO for over 20 years
- PM_{2.5} since 1999 when monitoring for this pollutant commenced

For the seventh pollutant, ozone, Massachusetts was designated as a non-attainment area for the 1997 eight-hour ozone standard of 0.08 ppm. Measurement data now shows that all monitors meet the 1997 standard statewide. In addition, EPA tightened the eight-hour ozone standard in 2008 to 0.075 ppm and designated all of Massachusetts except Dukes County as unclassifiable/attainment with the new standard. A few exceedances of the new eight-hour ozone standard have been measured at various locations in Eastern Massachusetts in recent years, however there have been no violations of the standard in the region since compliance is based on a 3-year average. It should be noted that cleaner air has been achieved since 1996, with regard to the old 1-hour NAAQS (EPA revoked the 1-hour standard in 2005), for all locations in the Greater Boston area, including the Hanscom Field communities.

Using actual air quality measurements collected throughout the region by the MassDEP over the last 25 years, the following progress has been documented:

- CO levels in the Greater Boston area have steadily declined since their peak in the 1970s. The last violation of the CO air quality standard occurred in 1986 in Boston over 25 years ago (see Figure 8-1). The entire state has been considered in attainment with the standard since April 2002.
- NO₂ levels in the Greater Boston area have declined since their peak in the late 1970s (see Figure 8-2). In January of 2010, EPA established a new 1-hour NO₂ standard of 100 ppb. In January of 2012, EPA designated all of Massachusetts as attainment/unclassifiable with the new standard.
- SO₂ levels in the Greater Boston area have also steadily declined since their peak in the early 1970s. The last violation of the SO₂ air quality standard occurred in 1972 in Boston. In June of 2010, EPA established a new 1-hour standard of 75 ppb along with new monitoring requirements that just began in January of 2013. All six monitors in the Commonwealth show levels that meet the new 1-hour standard (See Figure 8-3).
- PM₁₀ levels in the Greater Boston area have declined since the mid-1980s. In 2006, the EPA revoked the annual PM₁₀ standard. There have been no violations of the PM₁₀ air quality standard recorded in the Hanscom area (See Figure 8-4).
- PM_{2.5} levels in the Greater Boston area have declined since monitoring of this pollutant began in 1999. The daily standard was tightened in 2006 from 65 µg/m³ to 35 µg/m³. In December of 2012, the EPA tightened the annual standard from 15 µg/m³ to 12 µg/m³. No violations of the PM_{2.5} air quality standard have been recorded in the Hanscom area (see Figure 8-5).
- Lead levels in the air have declined 98 percent since the early 1980s mostly due to the removal of lead in gasoline. In October of 2008, the EPA tightened the lead standard from 1.5 µg/m³ to 0.15 µg/m³ averaged over a 3-month period. In February of 2012, EPA required lead monitoring for one year at the Nantucket Memorial Airport as part of their effort to improve the existing lead monitoring network at airports and industrial facilities. The highest daily value recorded at the airport in 2012 was 0.04 µg/m³, well below the new standard of 0.15 µg/m³. No violations of the lead air quality standard have ever been recorded in the Greater Boston area (see Figure 8-6).
- Ozone levels in the Greater Boston area have declined since their peak in the 1970s (see Figures 8-7 and 8-8). In 1997, EPA promulgated a new 8-hour ozone standard of 0.08 ppm. In 2008, EPA tightened the 8-hour standard to 0.075 ppm. Exceedances of the new 8-hour ozone standard have

been monitored at various locations in the Greater Boston area over recent years (see Figure 8-9), however no violations of the new standard have occurred in the Middlesex County area. The area is considered non-attainment with the 1997 standard and unclassifiable/attainment with the new 2008 standard. It should be noted that ozone monitoring show that Massachusetts meets the 1997 standard.

8.4 Effect of Federal and Massachusetts Regulations

Additional reductions in air pollution levels, specifically ozone, are assured over the next 20 years due to the following regulations that are already or will be in place:

8.4.1 Vehicle Standards and Regulations

EPA has enacted various vehicle and emission fuel standards to improve the average fuel economy of cars and light trucks.

EPA recently proposed draft rules on low-sulfur gasoline for 2017 which will reduce the fuel sulfur content down to 10 ppm along with stricter limits on tailpipe exhaust. This proposal known as the Tier 3 Vehicle Emission and Fuel standards will reduce the sulfur content in gasoline by 60 percent compared to the existing Tier 2 sulfur gasoline standard of 30 ppm. Based on EPA estimates, the proposed rule would decrease nitrogen oxides and volatile organic compounds by 80% and particulate matter by 70%.

The Corporate Average Fuel Economy (CAFE) standards enacted in 1975 and regulated by the National Highway Traffic Safety Administration (NHTSA) and EPA is intended to improve the average fuel economy of cars and light trucks and encourage consumers to purchase more fuel efficient vehicles. The recent agreement in 2011 with the government and thirteen automakers will increase fuel economy to 54.5 miles per gallon by 2025. These new standards will reduce mobile source emissions through more efficient and cleaner vehicles and reduced fuel usage.

In addition to regulations and standards, the increase of cleaner burning vehicles such as hybrid, electric, and alternative fuel vehicles in the fleet mix will further reduce mobile source emissions. These types of vehicles are more efficient with emissions much lower compared to conventional gasoline and diesel vehicles. Furthermore, with the implementation of electric, hybrid, and newer more efficient vehicles, future emissions will be lower when compared to today with the removal of older less efficient vehicles.

8.4.2 Massachusetts Vehicle Emission Regulations

Massachusetts has implemented an enhanced motor vehicle Inspection & Maintenance (I/M) program. The program includes an expansion to include diesel cars, trucks, and buses. It consists of an on-board diagnostic test (OBD) which checks the vehicles on-board computer, downloads the data and checks for any systems malfunctions. There is also an opacity test for medium and heavy-duty vehicles not equipped with OBD systems. Under the enhanced I/M program, testing is conducted annually and is designed to ensure vehicles are operating efficiently and identify and fix high polluting vehicles.

Massachusetts has also adopted the California Low Emissions Vehicle (LEV) program that imposes emission limits more stringent than the Federal Motor Vehicle Control Program (FMVCP) in 1995 and newer motor passenger cars and light-duty trucks. Massachusetts' law requires the Commonwealth to adopt the stricter of the federal or California emission standards for motor vehicles. Massachusetts has adopted the California zero emissions vehicle (ZEV) program, effective in 2007. This program requires percentages of new vehicles (passenger cars, light-duty trucks, and medium-duty vehicles), sold in

Massachusetts starting in 2007, and must be certified to meet certain emissions limits. The MassDEP revised the ZEV program in 2009, where automobile manufacturers were required to comply with fleet average greenhouse gas emissions levels in Massachusetts. The amendments in 2009 provide additional flexibility and incentives to automobile manufacturers to meet the mandate.

8.4.3 Greenhouse Gas Emissions

Climate change refers to shifts in weather patterns resulting from an increase in the average global temperature. These changes have both natural and man-made causes, and the latter are thought to be the result of increasing atmospheric concentrations of CO₂, methane (CH₄), NO₂ and other heat-trapping gases, commonly referred to as greenhouse gases (GHG). Human activities that produce these gases include energy production and transportation activities.

The Commonwealth has acknowledged climate change as an important environmental and economic issue and has developed an initial plan to begin to address greenhouse gas emissions. Massport was one of 15 state agencies and authorities that participated in development of the action plan, with specific attention to transportation system planning and transportation technology and operations. The first Massachusetts Climate Protection Plan was published in 2004 by the Office for Commonwealth Development.⁴⁹ The Massachusetts Climate Protection Plan is the state's initial step towards reducing emissions of greenhouse gases and improving energy efficiency. It proposes near-term actions aimed at protecting the climate, reducing pollution, reducing energy demand, and stimulating job growth through the development of sustainable energy resources and advanced technologies. Massport is participating on two of the Action Plan Teams associated with the plan, (i.e., Transportation System Planning and Transportation Technologies and Operations) with a focus on emissions reduction associated with airport operations.

In 2008, the Governor signed the Massachusetts Global Warming Solutions Act which sets targets for reducing GHG levels by 25 percent by 2020 and 80 percent by 2050 compared to 1990 levels. To aid in implementing the Global Warming Solutions Act, the MassDEP issued rules in December of 2008 for mandatory GHG reporting requirements on a wide array of sources. The rule required certain facilities register with the MassDEP by April of 2009 and report, certify, and verify emissions annually starting in April of 2010. In addition to the above programs, Massachusetts participates in the Regional Greenhouse Gas Initiative (RGGI) which commenced in September of 2008. The purpose of RGGI is to reduce GHG emissions from power plants through a cap and trade program. Massachusetts is one of nine northeastern states that participate in the program. Massachusetts also adopted the Green Communities Act in 2008 which provided legislation to increase energy efficiency, encourage investment in renewable energy, encourage green building design, and mandates that 15 percent of the electricity supplied by 2020 must be from renewable energy sources.

In addition, the Massachusetts Executive Office of Energy and Environmental Affairs revised the "MEPA Greenhouse Gas Emissions and Protocol" effective May of 2010. The revised policy requires certain projects under MEPA review, not specific to this *2012 ESPR*, to quantify potential annual GHG emissions for the baseline and preferred alternative and identify and conduct an alternatives analysis to evaluate mitigation measures to minimize or mitigate potential GHG emissions from the preferred alternative.

⁴⁹The complete Massachusetts Climate Protection Plan is available on-line at <http://www.mass.gov/Eocd/docs/pdfs/macclimateprotectionplan.pdf>.

8.4.4 Reformulated Gasoline and Vapor Recovery Systems

Massachusetts has adopted the federal regulations for reformulated gasoline. Reformulated gasoline (RFG) is designed to produce lower emissions of toxic substances from evaporation and to burn cleaner than conventional gasoline. Phase II of the reformulated gasoline program, with more stringent standards, began in the year 2000. In 2006, Massachusetts phased out the use of methyl tert-butyl ether (MTBE) which was a gasoline additive designed to boost the octane level. MTBE was being found in the groundwater due to leaky underground tanks and legislation was introduced to substitute MTBE with ethanol. Currently, RFG is being blended with ethanol in Massachusetts.

Massachusetts recently required that Stage II gasoline vapor recovery systems be decommissioned at gasoline dispensing stations based on the EPA rule that Stage II vapor recovery was no longer cost effective. Massachusetts has proposed Stage I regulatory revisions that certain gas dispensing facilities install a Stage I system that meets the California Air Resource Board requirements for Stage I Enhanced Vapor Recovery (CARB EVR) as well as monitoring system for vapor leaks.

8.4.5 Diesel Engines

In 2004, the EPA implemented a non-road diesel rule that requires more stringent controls on non-road diesel engines. These standards followed the Tier 3 emissions standards for nitrogen oxides and hydrocarbons for non-road vehicles that were introduced in 1998 and are to be phased into use between 2006 and 2008. The new Tier 4 exhaust emission standards, which are being phased-in between 2008 and 2014, will cut air pollution emissions from non-road diesel engines by over 90 percent. As part of these regulations, ultra-low sulfur diesel fuel (15 ppm sulfur content) for on-road diesel vehicles was phased-in from 2006 to 2010 and is expected to reduce exhaust emissions by 90 percent.

8.4.6 Stationary Source Emissions

Massachusetts has adopted regulations that will reduce stationary source (e.g., industrial sources and power plants) emissions of NO_x, a prime component of ground-level ozone (smog). These regulations included Reasonably Available Control Technology (RACT), Lowest Achievable Emission Rate (LAER), included in the Ozone Transport Region, NO_x Cap and Allowance trading program, and the U.S. EPA's Ozone Transport NO₂ State Implementation Plan (SIP).

8.4.7 Year 2012 Aircraft Emissions

This section and the next provide estimates of total annual air emissions generated by activities associated with Hanscom Field for the year 2012. The primary air pollutant sources at Hanscom Field are aircraft operations and groundside roadway traffic. Other sources include space heating emissions and fugitive emissions from fuel storage, fuel spillage, and aircraft refueling activities. Prior studies have shown that emissions from these latter sources are very small compared to the aircraft and groundside roadway traffic, and thus consistent with previous ESPRs are excluded with little effect on the results.⁵⁰ Annual aircraft emissions were calculated for the year 2012 at Hanscom Field. Pollutants associated with aircraft engines are CO, NO_x, PM₁₀, PM_{2.5}, CO₂, and VOC. The methodology for calculating the aircraft emissions is outlined below.

⁵⁰Speas Associates, with Bolt, Berenek & Newman, "Alternative Futures for Hanscom Field Policy Planning," 1977.

According to the EPA,⁵¹ an airport emissions inventory should concentrate on the emission characteristics of aircraft relative to the vertical column of air that ultimately affects ground level pollutant concentrations. This portion of the atmosphere, which begins at the earth's surface and is simulated in air quality models, is often referred to as the mixing zone. The aircraft operations of interest within this layer are defined as the landing and takeoff (LTO) cycle. The cycle begins when the aircraft approaches the airport on its descent from cruising altitude, lands, and taxis to the gate. It continues as the aircraft taxis back out to the runway for subsequent takeoff and climb out as it heads back up to cruising altitude. Thus, the five specific operating modes in an LTO are:

- Approach from 3,000 feet
- Taxi/idle-in
- Taxi/idle-out
- Takeoff
- Climb out to 3,000 feet

Actual numbers of aircraft operations at Hanscom Field for the years 1990, 1995, 2000, 2005 and 2012 are described in Chapter 3, Airport Activity Levels and shown in Table 8-4. The data in Table 8-4 show that the number of aircraft operations at Hanscom Field in 2012 decreased by 1.6 percent compared to the 2005.

The annual aircraft operations data provided for the air quality analysis were consistent with the operations presented in the noise analysis (See Chapter 7, Noise). To convert the aircraft operations for use in EDMS, the INM type for each aircraft from the noise analysis was assigned an aircraft and engine type using the databases provided within EDMS. Annual emissions were calculated by multiplying the number of operations for each noise classification by the emission factor for that classification for each mode of the LTO cycle.

Table 8-4 Aircraft Operations at Hanscom Field

Year	Number of Operations
1990	232,700
1995	190,300
2000	212,400
2005	169,955
2012	167,845
Percent Change: 1990 to 2005	-27%
Percent Change: 1995 to 2005	-11%
Percent Change: 2000 to 2005	-20%
Percent Change 2005 to 2012	-1.6%

Source: Massport

The aircraft emission factors for CO, NO_x, PM₁₀, PM_{2.5}, CO₂, and VOC used to calculate the annual aircraft emissions at Hanscom Field in the 2012 *ESPR* were taken primarily from the FAA Emissions and Dispersion Modeling System (EDMS) model (Version 5.1.4.1).⁵² An earlier version of EDMS (4.3) was used for the previous *ESPR*'s and has been updated ten times since the 2005 *ESPR*. The differences in aircraft emission rates between these versions of EDMS are significant, especially for smaller general

⁵¹U.S. EPA, Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources, Office of Air and Radiation, EPA-450/4-81-026d (Revised), 1992.

⁵²FAA, Emissions and Dispersion Modeling System (EDMS) Reference Manual, Prepared for the FAA by CSSI, Washington, D.C., June, 2013.

aviation (GA) aircraft. When EDMS converted to Version 5.0 in January of 2007, the upgrade represented a significant improvement in capabilities and functionality over previous versions. Among the many updates to the model included two significant changes from the previous versions: 1) new, dynamic emissions module computes aircraft LTO emissions based on performance parameters and weather conditions, and 2) Boeing Fuel Flow Method 2 is used to scale emissions for a contiguous range of weather conditions, rather than just standard atmospheric conditions. The Version 5 update changed the methodology for calculating fuel flow and time in mode for each of the modes of the LTO cycle. This is especially apparent for the smaller GA aircraft like the Cessna 150 which comprise approximately 75 percent of the total operations at Hanscom in 2012. Because of the numerous updates to EDMS over the past years, the 2005 operations were updated with the newer version of EDMS which results in aircraft emissions that are significantly higher for the same fleet and level of operations compared to emissions calculated using the older EDMS Version 4.3. This will allow for a more accurate comparison of 2005 and 2012 aircraft emissions. The emissions shown in Table 8-5 for 2005 (Version 5.1.4.1) are the recalculated results. It should also be noted that in 2005, emission factors for CO₂, PM₁₀ and PM_{2.5} were not available for all types of aircraft, and therefore emissions were calculated separately with spreadsheets. However, with the improvements to EDMS, emissions for these pollutants were calculated for each of the aircraft operations for 2005 and 2012 and are presented in Table 8-5.

Table 8-5 Emissions from Aircraft Operations at Hanscom Field (1,000s of kg/yr)

Year	CO	NO _x	VOC	PM ₁₀ ¹	PM _{2.5} ¹	CO ₂ ³
1985 ²	698.8	14.2	38.3	2.6	2.6	7,280.6
1995 ²	409.2	14.9	27.9	2.3	2.3	6,727.8
2000 ²	591.2	25.4	39.4	2.3	2.3	10,108.1
2005 (EDMS Version 4.3)	483.6	28.0	58.1	3.0	3.0	11,806.6
2005 (EDMS Version 5.1.4.1) ³	1,670	34.1	112.7	13.5	13.5	19,233.1
2012	1,123	31.9	80.4	9.9	9.9	16,356.0
Percent Change: 1985 to 2005	-31%	+97%	+52%	+15%	+15%	+62%
Percent Change: 1995 to 2005	+18%	+88%	+108%	+30%	+30%	+75%
Percent Change: 2000 to 2005	-18%	+10%	+47%	+30%	+30%	+17%
Percent Change: 2005 to 2012 ⁴	-33%	-7%	-29%	-27%	-27%	-15%
Notes:						
1. PM ₁₀ and PM _{2.5} emissions for some aircraft and CO ₂ emissions for all aircraft were calculated separately with a spreadsheet. The EDMS does not contain PM emission rates for some aircraft and does not include CO ₂ emission for any aircraft.						
2. Emissions for 1985, 1995, and 2000 were revised from the 2000 <i>ESPR</i> using the EDMS Version 4.3.						
3. Emissions for 2005 were revised from the 2005 <i>ESPR</i> using EDMS Version 5.1.4.1.						
4. Percent Change is based on 2005 and 2012 EDMS Version 5.1.4.1.						

Aircraft engine emission factors in mass per time (e.g. grams per second or kilograms per hour) were based on the EDMS default factors for each aircraft and engine type for idle, takeoff, climb out, and approach movements which are a function of the engine's power setting and resultant fuel flow. EDMS default time-in-mode (TIM) data were also used for each of the phases of the LTO cycle. Aircraft emissions for each of the modes of the LTO were calculated for each type of aircraft by multiplying the number of operations by the emission factor for each operation phase and the TIM. These calculations were performed by EDMS.

Table 8-5 shows the estimates of the total emissions of CO, NO_x, VOC, PM₁₀, PM_{2.5}, and CO₂ at Hanscom Field for 1985, 1995, 2000, 2005, and 2012. The data in Table 8-5 reveal that emissions for all six pollutants decreased between 2005 and 2012 based on revising the 2005 inventory for the current EDMS version model. The percentage changes in the aircraft emissions between the different years shown in Table 8-5 do not correlate with the percent changes in the number of aircraft operations shown

in Table 8-4 because the mix of the aircraft types is different in each of the five years and the aircraft emissions for 1990, 1995, 2000, and 2005 were developed using an older version of the EDMS model as well as external emission factors for PM₁₀ and CO₂.

The changes in the emissions of the six air pollutants between 2005 and 2012 shown in Table 8-5 are the result of differences in the number of operations of different types of aircraft. The emission rates for each type of aircraft do not change with time, rather the relative amount of each type of aircraft in the mix using Hanscom Field changes for each of the different years. The operations in 2012 included a different mix of aircraft from 2005, and the emissions depend on the aircraft type, the time spent in each mode of the LTO cycle at the airport (a characteristic that varies by aircraft type), and the passenger-carrying capacity of the aircraft. Similarly, for comparisons between 1990, 1995, 2000 and 2005, the changes in the aircraft emissions are the result of differences in the number of operations of different type aircraft which varies for each year, including the time spent in each mode of the LTO cycle at the airport.

To provide some perspective on the relative contribution of Hanscom Field aircraft emissions to regional air quality and to demonstrate that the increases that have occurred are small, Table 8-6 shows the total air emissions for Middlesex County. The emissions data for Middlesex County were obtained from the U.S. EPA National Emission Inventory (<http://www.epa.gov/ttnchie1/net/2011inventory.html>) for the most recent available year 2011. The 2012 aircraft emission totals in Table 8-5 as a percent of the Middlesex County emissions in Table 8-6 are as follows:

- CO = 0.80 percent
- NO_x = 0.14 percent
- VOC = 0.30 percent
- PM₁₀ = 0.06 percent
- PM_{2.5} = 0.21 percent
- CO₂ = 0.26 percent

Table 8-6 2011 Emissions from All Sources in Middlesex County, Massachusetts (1,000s of kg/yr)

Source Type ¹	CO	NO _x	VOC	PM ₁₀	PM _{2.5}	CO ₂
Point	9,380	5,457	15,321	15,151	3,642	655,608
Mobile	132,931	17,887	11,296	1,311	1,014	5,566,911
Total	142,311	23,352	26,617	16,462	4,657	6,222,519

8.4.8 Year 2012 Motor Vehicle Emissions

A mesoscale air quality analysis was conducted for the motor vehicle traffic associated with activities at Hanscom Field. A mesoscale analysis calculates emissions over a larger area compared to a microscale analysis which calculates impacts from a much smaller area (e.g. roadway intersections). Consistent with MassDEP guidance for performing a mesoscale analysis⁵³ (DEP, 1991), total annual emissions of CO, NO_x, PM₁₀, PM_{2.5}, CO₂, and VOC were calculated using the most recent version of U.S. EPA's MOBILE emission model, MOBILE6.2. The mesoscale air quality study area is the same as the traffic study area analyzed for the 2005 and 2012 ESPRs.

The vehicle miles traveled (VMT) for each roadway segment in the study area was calculated by multiplying the length of each segment by the average weekday daily Hanscom Field traffic volume on

⁵³Massachusetts Department of Environmental Protection, *Guidelines for Performing Mesoscale Analysis of Indirect Sources*, Division of Air Quality Control, May 1991.

the segment. These calculations were performed in an excel spreadsheet using emission rates predicted by the MOBILE6.2 model with Massachusetts specific inputs. Average 24-hour traffic volumes were based on peak AM and PM volumes assuming the peak volumes represents 10 percent of the daily traffic. The average weekday daily traffic volumes, which are typically greater than the average daily volumes for an entire week including weekends, were multiplied by 365 to conservatively estimate the annual emissions for the study area.

The air pollutant emissions for each roadway segment were calculated by multiplying the VMT on each segment by the MOBILE6.2 predicted pollutant specific emission factor in grams per mile. The MOBILE6.2 model was run using inputs that were provided by the MassDEP. These emission factors were calculated for the time of year of concern for each pollutant (winter-CO and PM₁₀/PM_{2.5}, summer-VOC, NO_x, CO₂) using an average daily speed for each roadway link of 25 to 40 mph. For this analysis, PM₁₀ and PM_{2.5} emissions are composed of organics, sulfates, and lead salts from tailpipe, brake wear, and tire wear.

The results of the mesoscale analysis are presented in Table 8-7 and show that emissions from Hanscom Field traffic for 2012 declined significantly for all pollutants, compared to 1985, 1995, 2000, and 2005 except emissions of CO₂ which are higher than those calculated for 2005. The general decline in motor vehicle emissions with time is a result of the upgrading of the fleet mix through the replacement of older vehicles with new cleaner vehicles that must meet more-strict emission standards. The traffic generated by Hanscom Field increased between 2005 and 2012. Generally the reduction in motor vehicle emission rates more than compensates for the increase in traffic, resulting in net emission decreases. For CO₂, the MOBILE6.2 reductions in emission rates are smaller and do not fully offset the higher traffic volumes, resulting in a slight emissions increase compared to 2005.

Table 8-7 Emissions from Hanscom Field Vehicular Traffic (1,000s of kg/yr)

Year	CO	NOx	VOC	PM10	PM2.5	CO2
1985 ¹	49.2	5.1	5.0	0.4	0.4	-
1995 ¹	30.3	3.9	2.9	0.6	0.6	-
2000 ²	60.8	6.9	3.0	0.21	0.16	1,495.5
2005	36.1	4.1	1.6	0.14	0.10	1,312.3
2012	19.05	2.18	0.86	0.10	0.06	1,555.4
Percent Change: 1985 to 2005	-27%	-20%	-68%	-65%	-75%	-
Percent Change: 1995 to 2005	+19%	+5%	-45%	-77%	-83%	-
Percent Change: 2000 to 2005	-41%	-41%	-47%	-33%	-38%	-12%
Percent Change: 2012 to 2005	-47.2%	-46.8%	-46.3%	-28.6%	-40.0	+18.5%
Notes:						
1. Data were not available to update the 1985 and 1995 emissions to MOBILE6.2 or to calculate CO2 emissions for those years.						
2. The 2000 Emissions were revised from the 2000 ESPR using the MOBILE6.2 model with MassDEP model inputs.						

8.4.9 Total Year 2012 Emissions

The combined pollutant emissions from both aircraft operations and groundside motor vehicle travel at Hanscom Field are shown in Table 8-8 for each of the six pollutants in 1985, 1995, 2000, 2005, and 2012. Table 8-8 shows that the sum of emissions for aircraft operations and motor vehicle traffic for NO_x, CO, VOC, PM₁₀, PM_{2.5} and CO₂ have decreased between 2005 and 2012.

8.4.10 Analysis of Future Scenarios

As discussed earlier in this chapter, the future air quality effects of Hanscom Field are predicted based on an emissions burden analysis of airside operations and groundside motor vehicle traffic for the 2020 and

2030 future planning scenarios. The 2012 *ESPR* planning scenarios are used to evaluate the potential cumulative environmental effects that could occur if Hanscom Field reaches the airport activity levels that are described in Chapter 3, Airport Activity Levels. The 2020 and 2030 scenarios represent estimates of what could occur (not what will occur) in the future using certain planning assumptions and are not necessarily recommended outcomes. The future service scenarios are consistent with Massport's 1980 Regulations for Hanscom Field, which prohibit scheduled commercial passenger services with aircraft having more than 60 seats.

Table 8-8 Total Air Emissions at Hanscom Field (1,000s of kg/yr)

Pollutant/Source	Year						Percent Change (Total)			
	1985	1995	2000	2005 (EDMS 4.3)	2005 (EDMS 5.1.4.1)	2012	1985 to 2005	1995 to 2005	2000 to 2005	2005 to 2012
CO										
Aircraft	698.8	409.2	591.2	483.6	1,670	1,123				
Ground Vehicles	49.2	30.3	60.8	36.1	36.1	19.05				
Total	748.0	439.5	652.0	519.7	1,706.1	1,142.1	-31%	+18%	-20%	-33.1%
NO_x										
Aircraft	14.2	14.9	25.4	28.0	34.1	31.9				
Ground Vehicles	5.1	3.9	6.9	4.1	4.1	2.18				
Total	19.3	18.8	32.3	32.1	38.2	34.1	+66%	+71%	-1%	-10.7%
VOC										
Aircraft	38.3	27.9	39.4	58.1	112.7	80.4				
Ground Vehicles	5.0	2.9	3.0	1.6	1.6	0.86				
Total	43.3	30.8	42.4	59.7	114.3	81.3	+38%	+94%	+41%	-28.9%
PM₁₀										
Aircraft	2.6	2.3	2.3	3.0	13.5	9.9				
Ground Vehicles	0.4	0.6	0.21	0.14	0.14	0.10				
Total	3.0	2.9	2.51	3.14	13.6	10.0	+5%	+8%	+25%	-26.5%
PM_{2.5}										
Aircraft	2.6	2.3	2.3	3.0	13.5	9.9				
Ground Vehicles	0.4	0.6	0.16	0.10	0.10	0.06				
Total	3.0	2.9	2.46	3.10	13.6	9.96	+3%	+7%	+26%	-27%
CO₂										
Aircraft	7,280.6	6,727.8	10,108.1	11,806.6	19,233	16,356				
Ground Vehicles	-	-	1,495.6	1,312.3	1,312.3	1,555.4				
Total	-	-	11,603.6	13,118.9	20,545	17,911	-	-	+13%	-12.8%
Note:										
1. Data to calculate the ground vehicle CO ₂ emissions for 1985 and 1995 were not available; therefore, total CO ₂ emissions for these years are not available for comparison with later years										
2. Percent total based on EDMS 5.1.4.1 to estimate aircraft emissions for 2005 and 2012.										

Since all future scenarios assume more aircraft operations, increases from current emission levels for the airport are expected. However, it should be noted that there are limitations in predicting future emissions beyond 20 years from the baseline for aircraft operations using EDMS. The EDMS model is constantly reviewed and updated to include new aircraft and engine types along with the latest emission factors from the International Civil Aviation Organization (ICAO) engine exhaust emission data bank. It does not incorporate future year technology changes such as the use of alternative fuels, more efficient engines or future regulatory emissions standards. Therefore, the predicted 2020 and 2030 year emission levels represent a conservative estimate of the future conditions. Estimated emission level increases and their associated impacts on air quality under the future scenarios are described below.

8.4.11 Future Aircraft Emissions

The estimation of future aircraft emissions followed the methodology outlined earlier in this chapter. For comparative purposes, Table 8-9 shows the annual number of operations and passengers for 2012 and the future planning scenarios. Tables containing the aircraft data used for the emissions calculations can be found in Appendix E.

Table 8-9 Aircraft Operations at Hanscom Field for 2012 and Forecast Scenarios

Year/Scenario	Number of Operations	Number of Passengers
2005	169,955	17,457
2012	167,845	8,609
2020	170,244	20,280
2030	195,892	35,490
Percent Change:		
2012 to 2020	+1.7%	+135%
2020 to 2030	+15.0%	+75%
1. The nighttime operations presented in the 2012 ESPR differ slightly from those published in the Hanscom Field Annual Noise Report. This discrepancy is due to the difference in the timing of the preparation for the two reports. Each report used the best available data at the time of the analysis for that report. The difference of approximately 0.3 daily nighttime operations or 0.07% of all daily operations would change computed noise levels by less than 0.1 dB, which is imperceptible and would not change the analysis presented.		

Table 8-10 summarizes the annual aircraft emissions for CO, NO_x, PM₁₀, PM_{2.5}, CO₂, and VOC, for the 2020 and 2030 future planning scenarios, and compares these emissions to year 2012. In general, aircraft emissions forecasted for each of the future scenarios would be higher than those for the year 2012 based on a predicted growth in operations. The exception is emissions of CO for 2020 which show a slight decrease compared to 2012. The largest increases in aircraft emissions are predicted for NO_x, VOC and CO₂, with the smallest increases predicted for CO, PM₁₀ and PM_{2.5}.

As expected, emissions of all six pollutants, except 2020 CO emissions, for the two future planning scenarios would be higher than the emissions calculated for the year 2012. These emission changes would occur for two reasons: (1) increase in the total number of aircraft operations and the number of passengers carried, and (2) changes in the aircraft fleet mix. The air pollutant emission rates for each aircraft/engine combination are assumed not to change with time.

The percent decrease in CO for 2020 is approximately 2.2 percent while the percent increase in 2030 is approximately 13.2 percent. The percent increase in emissions from 2020 to 2030 is similar to the percent increase in the number of operations during the same time. The emissions changes for all pollutants would result from changes in the mix of the aircraft for each scenario. The emissions of each pollutant would vary with the type of aircraft and by the mode and time of operation of the aircraft during the LTO cycle.

Table 8-10 Emissions from Aircraft Operations at Hanscom Field for 2012 and Forecast Scenarios (1,000s of kg/yr)

Year	CO	NO _x	VOC	PM ₁₀	PM _{2.5}	CO ₂
2005	1,670	34.1	112.7	13.5	13.5	19,233
2012	1,123	31.9	80.4	9.9	9.9	16,356
2020	1,096	41.1	105.4	10.1	10.1	20,666
2030	1,262	53.2	134.3	11.8	11.8	26,519

Note: All calculations generated using EDMS v5.1.4.1.

Even under the highest emissions scenario (2030 future year), the total Hanscom Field aircraft emissions would still be a very small percentage of total Middlesex County emissions (as a percent of Massachusetts emissions for CO₂) (see Table 8-6) and lower than historic levels.

- CO = 0.89 percent
- NO_x = 0.23 percent
- VOC = 0.50 percent
- PM₁₀ = 0.07 percent
- PM_{2.5} = 0.25 percent
- CO₂ = 0.43 percent

8.4.12 Future Vehicular Emissions

A mesoscale air quality emissions analysis was done for Hanscom Field motor vehicle traffic for the same future planning scenarios used to estimate aircraft emissions. The study area and methodology for calculating groundside vehicular emissions is the same as described earlier for 2012. Table 8-11 summarizes the annual emissions from groundside vehicular traffic for CO, NO_x, PM₁₀, PM_{2.5}, CO₂, and VOC for the future growth scenarios. Tables showing the data used to calculate the motor vehicle emissions are included in Appendix E. Emissions for 2020 are estimated to decrease for all pollutants when compared to 2012 except CO and CO₂ which are estimated to increase.

The predicted increases in motor vehicle emissions reflect projected increases in Hanscom Field-related traffic associated with the higher number of aircraft passengers for the future scenarios listed in Table 8-9. The motor vehicle emission rates predicted with the MOBILE6.2 model for all pollutants except CO₂ are predicted to decrease between 2012 and 2030 with the largest decrease predicted for NO_x emissions. A slight increase in motor vehicle CO₂ emission rates is predicted over this period. Even though vehicle emission rates are predicted to decrease, the additional traffic volumes predicted in 2020 and 2030 is greater than the lower emissions generated by MOBILE6.2 for each year and pollutant which is attributing to the predicted increases.

The smallest percent increase in motor vehicle emissions would occur for CO, and the largest percent increase would occur for CO₂. The percent increases in VOC, PM₁₀, and PM_{2.5} emissions from motor vehicles are predicted to be between those for CO and CO₂.

Table 8-11 Emissions from Hanscom Field Vehicular Traffic for 2012 and Forecast Scenarios (1,000s of kg/yr)

Year	CO	NO _x	VOC	PM10	PM2.5	CO2
2005	36.1	4.1	1.6	0.14	0.10	1,312.3
2012	19.05	2.18	0.86	0.10	0.06	1,555.0
2020	20.12	0.92	0.69	0.10	0.05	1,984.7
2030	34.29	0.98	1.05	0.16	0.07	3,335.7

As Hanscom Field generated traffic is only a small percent of the total traffic in the nine square mile traffic study area (e.g., approximately three percent of the total traffic in the year 2012), the increase in total area wide emissions associated with any future Hanscom Field scenario is quite small. For example, although Table 8-11 suggests CO emissions from Hanscom Field traffic could double over an 18-year period for the 2030 growth scenario, total CO emissions within the local traffic study area would increase only about three percent for this future scenario and still remain below historic levels.

8.4.13 Total Future Emissions and Air Quality Concentrations

The combined emissions from both aircraft operations and motor vehicle traffic at Hanscom Field are shown in Table 8-12 for the six parameters. Table 8-13 summarizes the predicted changes in total emissions per passenger between the two future scenarios and the year 2012. These data are the sum of the emissions calculated in the previous two sections.

Table 8-12 shows that with the exception of CO in the 2020 scenario, total emissions will increase each year compared to 2012 emissions. Aircraft operations dominate the emission totals, and as one would expect, the highest emissions for both future planning years would occur for the 2030 scenario. The predicted increases in pollutant emissions and slight decreases in CO in total emissions for 2020 and 2030 are a result of the assumed changes in the fleet mix, the assumed increase in aircraft operations and passengers carried, and the assumed increase in associated motor vehicle traffic.

Table 8-13 shows that the emissions per passenger for each air pollutant would decrease significantly for each of the two future planning scenarios compared to 2012. Emissions per passenger for each scenario were calculated by dividing the total emissions for each pollutant by the projected number of passengers carried for each future planning scenario. The largest decrease in emissions per passenger would occur for CO.

Even under the highest emissions scenario (2030), the total future Hanscom Field aircraft and motor vehicle emissions would still be less than one percent of the total emissions for Middlesex County:

- CO = 0.91 percent
- NO_x = 0.23 percent
- VOC = 0.51 percent

Table 8-12 Total Air Emissions at Hanscom Field for 2012 and Forecast Scenarios (1,000s of kg/yr)

Pollutant/Source	2012	2020	2030
CO			
Aircraft	1,123	1,096	1,262
Ground Vehicles	19.05	20.1	34.3
Total	1,142.1	1,116.1	1,296.3
NO_x			
Aircraft	31.9	41.1	53.2
Ground Vehicles	2.18	0.92	0.98
Total	34.1	42.0	54.2
VOC			
Aircraft	80.4	105.4	134.3
Ground Vehicles	0.86	0.69	1.05
Total	81.3	106.1	135.4
PM₁₀			
Aircraft	9.9	10.1	11.8
Ground Vehicles	0.10	0.10	0.16
Total	10.0	10.2	12.0
PM_{2.5}			
Aircraft	9.9	10.1	11.8
Ground Vehicles	0.06	0.05	0.07
Total	9.96	10.2	11.9
CO₂			
Aircraft	16,356	20,666	26,519
Ground Vehicles	1,555.0	1,984.7	3,355.7
Total	17,911	22,650.1	29,874.7

Table 8-13 Percent Change in Total Air Pollution Emissions per Passenger at Hanscom Field for Forecast Scenarios Compared to 2012 Baseline

Year	CO	NOx	VOC	PM10	PM2.5	CO2
2020	-59%	-48%	-45%	-57%	-57%	-46%
2030	-72%	-61%	-60%	-71%	-71%	-60%

- PM₁₀ = 0.07 percent
- PM_{2.5} = 0.25 percent
- CO₂ = 0.48 percent

Maximum air quality concentrations in 2030 for CO, NO₂, PM₁₀, and PM_{2.5} were estimated at the same ten community receptors surrounding the airport that were assessed in the 2005 *ESPR*:

1. Concord: closest residential area
2. Bedford: closest residential area
3. Lexington: closest residential area
4. Lincoln: closest residential area
5. Minute Man National Historical Park
6. Great Meadows National Wildlife Refuge
7. Concord Center
8. Bedford Center
9. Lexington Center
10. Lincoln Center

The first six receptors were located at the closest downwind distance from the center of the airfield to residential or conservation land outside the Massport boundary in the respective towns. Since air pollutant concentrations due to Hanscom Field operations decrease with distance from the airfield, concentrations at any other sensitive receptor in one of the four adjoining towns will be less than those predicted for receptors one through four.

The maximum concentrations calculated for the ten community locations for the year 2005 presented in the 2005 *ESPR*⁵⁴ were scaled with the emissions calculated for the 2012 *ESPR* to obtain year 2012 results. Scaling is appropriate given that modeling parameters (i.e. source and receptor locations) have not changed from the 2005 *ESPR* and only the emission rate for each pollutant is changing. The scaling was achieved by multiplying the maximum predicted concentration for each air pollutant and averaging the period for the year 2005 in the 2005 *ESPR* by a scaling ratio. The total emissions predicted in this 2012 *ESPR* for the scenario with the largest total emissions (i.e., the 2030 Growth scenario) was divided by the 2005 total emissions presented in the 2005 *ESPR* to create the scaling ratio. After adding in revised background concentrations (see Table 8-3), the maximum predicted concentration for each air pollutant for the 2030 growth scenario was obtained (see Table 8-14).

The concentration levels given in Table 8-14 are conservative since they are derived from the SCREEN3 dispersion modeling originally presented in the 1995 *GEIR* that assumes all airborne emissions up to 3,000 feet are simulated as being released at ground level (see 1995 *GEIR*, p. 2-152). Actual air concentrations from Hanscom Field operations will be less than these estimates. Note that the majority of the total predicted concentrations in Table 8-14 come from the conservative background levels assumed

⁵⁴Massachusetts Port Authority, 2000 *L. G. Hanscom Field Environmental Status and Planning Report*, EOE # 5484/8696, July 2002.

in the analysis (see Table 8-3), not Hanscom Field operations. Thus, maximum concentrations for the 2030 planning scenario will be less than those listed in Table 8-14 if activity levels reach those of the future scenarios.

Table 8-14 Predicted Maximum Air Concentrations in 2020 at Ten Community Receptors ($\mu\text{g}/\text{m}^3$)

	Receptor	CO 1 Hour	CO 8 Hour	NO ₂ 1 Hour	NO ₂ Annual	PM ₁₀ 24 Hour	PM ₁₀ Annual	PM _{2.5} 24 Hour	PM _{2.5} Annual
Concentration from Hanscom Operations ¹	1	3073.1	2064.0	67.9	4.7	8.4	1.3	8.6	1.3
	2	2549.7	1784.3	57.9	4.1	8.4	1.3	8.6	1.3
	3	1596.3	1117.0	36.3	2.9	4.2	0.8	4.3	0.9
	4	1545.6	1081.1	33.4	2.9	4.2	0.8	4.3	0.9
	5	1897.2	1272.4	43.3	3.5	4.2	0.8	4.3	0.9
	6	1100.7	770.3	24.6	1.8	2.1	0.6	2.1	0.6
	7	744.2	521.7	17.0	1.8	2.1	0.6	2.1	0.6
	8	1455.6	1018.9	31.6	2.9	4.2	0.6	4.3	0.6
	9	732.7	511.9	17.0	1.8	2.1	0.6	2.1	0.6
	10	750.7	526.6	17.0	1.8	2.1	0.6	2.1	0.6
Total Concentration Including Background ²	1	5143.1	3559.0	167.3	42.7	46.4	18.3	29.9	10.5
	2	4619.7	3279.3	157.3	42.1	46.4	18.3	29.9	10.5
	3	3666.3	2612.0	135.7	40.9	42.2	17.8	25.6	10.1
	4	3615.6	2576.1	132.8	40.9	42.2	17.8	25.6	10.1
	5	3967.2	2767.4	142.7	41.5	42.2	17.8	25.6	10.1
	6	3170.7	2265.3	124.0	39.8	40.1	17.6	23.4	9.8
	7	2814.2	2016.7	116.4	39.8	40.1	17.6	23.4	9.8
	8	3525.6	2513.9	131.0	40.9	42.2	17.6	25.6	9.8
	9	2802.7	2006.9	116.4	39.8	40.1	17.6	23.4	9.8
	10	2820.7	2021.6	116.4	39.8	40.1	17.6	23.4	9.8
Air Quality Standard or Guideline ($\mu\text{g}/\text{m}^3$)		40,000	10,000	188/320 ³	100	150	50	35	12
Notes: 1. Air concentrations are derived from the SCREEN3 dispersion modeling from Hanscom Field operations that assumes all airborne emissions up to 3,000 feet are simulated as being released at ground level. Actual air concentrations will be less than these estimates because emissions above ground level will have a significantly reduced impact on ground-level locations. 2. Background levels measured at conservative urban location (Kenmore Square, Boston), see Table 8-3 3. The 188 $\mu\text{g}/\text{m}^3$ represents the EPA 1-hour NAAQS, while the 320 $\mu\text{g}/\text{m}^3$ represents the MassDEP 1-hour NO ₂ Policy Guideline.									

The estimated maximum concentrations predicted for 2030 would be in compliance with the NAAQS and the MassDEP 1-hour NO₂ Policy Guideline. Concentration levels for the 2020 future growth scenario would be lower because emissions for this case are lower. Thus, it can be concluded that the air pollutant emissions shown in this 2012 *ESPR* for aircraft and motor vehicles at Hanscom Field for all future planning scenarios would not have an adverse impact on local air quality in Bedford, Lexington, Concord, and Lincoln. Aircraft emissions currently comprise less than one percent of regional air emissions from all sources within Middlesex County and that will remain so in the future operating scenarios.

Residents in Bedford near Runway 29 have expressed concerns about particulate deposition. Visible particles that settle from the air onto surfaces like outdoor lawn furniture or cars originate from many other sources aside from Hanscom operations in the vicinity of Hanscom Field. These sources include motor vehicles on Route 128/I-95 and local roads, aircraft, and fuel oil combustion used to heat homes and businesses. Emissions from motor vehicles on Route 128/I-95, especially diesel trucks, are the largest nearby source of airborne particulate matter and are significantly greater than particulate emissions from Hanscom.

Air Quality monitoring performed on four sides of Hanscom Field in 1996 did not reveal any effect on local air quality from the airfield's operations, but did suggest that local air quality is affected by traffic on nearby Route 128/I-95 (see *1995 GEIR*, p. 2-151).

Conservative air concentration estimates of 24-hour PM₁₀ levels at the homes near the end of Runway 29 reveal relatively low levels of particulate matter from aircraft operations equal to only one to five percent of the NAAQS for the 2030 planning scenario.

8.5 Potential Environmentally Beneficial Measures

Maximum air quality concentrations for all future planning scenarios will comply with the NAAQS. Still, Massport intends to continue implementing beneficial measures to reduce on-site emissions from all sources. These are discussed below for fuel handling, ground service equipment, building heating/cooling, aviation support, airside operations, and the clean fuel vehicle program.

8.5.1 Fuel Handling Emission Controls

Massport does not own or operate fuel distribution facilities at Hanscom Field, but does fuel its vehicles on-site. A survey of fixed based operators (FBOs) at Hanscom Field found that vapor recovery is being used on all fuel storage tanks subject to MassDEP regulation and that Stage II vapor controls are used at all gasoline-dispensing facilities. Massachusetts has recently proposed an upgrade to Stage I vapor recovery systems that meets the California Air Resource Board requirements for Stage I Enhanced Vapor Recovery (CARB EVR) as well as systems for monitoring vapor leaks. Hanscom will adhere to the future MassDEP regulations in fuel handling emissions when promulgated.

8.5.2 Fuel Conversion of Ground Service Equipment and Massport Groundside Vehicles

An inventory of current ground service equipment (GSE) and Massport groundside fleet vehicles at Hanscom Field is provided in Table 8-15. At present, eight percent of the GSE and fleet vehicles at Hanscom Field are alternatively fueled, either by electricity or propane, which is a slight decrease compared to *2005 ESPR* of eleven percent, but an increase from the three percent level reported in the *2000 ESPR*.

Table 8-15 Ground Service Equipment and Fleet Vehicles by Fuel Type at Hanscom Field

Type of Vehicle or Equipment	Gasoline	Diesel ¹	Propane	Electric
Massport Fleet				
Cars/Vans/SUVs/Pick-up Trucks	8	3		
Golf Carts				4
Massport Ground Service Equipment				
Snowplow Trucks/Snowblowers/Sweepers	1	16		
Large Field Tractors	2	2		
Front-end Loaders		3		
Forklifts			1	
Small Tractors/Mowers/Bobcat		1		
FBO: Signature				
Cars/Vans/Pickup Trucks	12			
Snowplows/Deicing Trucks		3		
Fuel Tanker Trucks		7		
Belt Loader/Tugs/Air Stairs	5	5		2
Golf Carts				2
Ground Power Units		3		
FBO: Jet Aviation				
Cars/Vans/Pickup Trucks	5			
Tugs/Belt Loaders/Air Stairs	8	3		6
Deicing Trucks	2	1		
Fuel Tanker Trucks		6		
Golf Carts				
Ground Power Units	2	6		
Forklifts			1	
Small Tenants²				
Cars/Vans/SUVs	36	2		
Tugs	1	6		
Heavy Equipment-Trucks/Loaders/Ambulances	1	26		
Forklifts	1			
Total³	84	93	2	14
Notes:				
1. As part of EPA regulations, ultra-low sulfur diesel fuel for on-road diesel vehicles was phased-in starting in 2006.				
2. Tenant vehicles not specifically addressed as part of the Jet Aviation or Signature Flight support fleet.				
3. Electric and propane represent 8.3 percent of total Ground Service Equipment and fleet vehicles (16 of 192).				

Source: Massport .

Ground service and landside conversions to alternative fuels were considered and discussed in the 2005 *ESPR*. Due to the limited amount of GSE in operation at Hanscom Field, this category is not a significant source of air pollution. The majority of GSE operations with Massport-owned equipment involve airport maintenance (e.g. snow plowing, snow blowing and runway sweeping) with large vehicles that, given their power needs, are not presently candidates for conversion to alternate fuels. Fleet vehicles are more likely candidates for the use of alternative fuels as discussed in Section 8.5.5 below along with electric ground support equipment (GSE) and gate electrification. Alternative fuels include electric, hybrid, biodiesel, propane, and natural gas.

As cited above, Massport has made progress in this area and will consider additional Alternative Fueled Vehicles (AFVs), including electric and hybrid for new vehicle purchases in the future. There are no electric recharging stations at Hanscom; however, tenants have electric-only vehicles in their fleet that require 110/220v wall plug connections. GSE operations by the tenants involve a mix of large and small equipment, some of which are electric-powered. While power needs for some of this equipment (e.g. the snow plows, tanker fuel trucks) preclude their use of alternative fuels, Massport will encourage tenants to consider alternatively fueled GSE, where appropriate, when making purchases of new equipment.

8.5.3 Building Heating and Cooling

Massport does not operate a central energy plant for facilities at Hanscom Field. Buildings that use natural gas for space heating are the Civil Air Terminal (15), Hangars 10, 11, 11A, 12, 13, 14, 15, 16 and 21. Buildings that use propane for space heating are Hangars 1 (Floor heat), 2, 3, the Customs Trailer (30) and the Sand Storage Building (9A). The offices of Hangar 1, the two Maintenance Garages (7 and 20) and Hangar 12A use #2 oil for space heating. Hangar 24 is currently under redevelopment by Rectrix Aviation as a LEED Silver facility, which will utilize clean burning natural gas. Building 22, the Jet Aviation vehicle maintenance shop, uses a recycled oil-fired burner for space heating. The office portions of Massport buildings use electricity for air conditioning. In summary, Massport buildings at Hanscom Field only use clean fuels for heating, namely natural gas, propane, and #2 oil. Building heating and cooling emissions are already minimized through the exclusive use of clean fuels. A small amount of waste oil is used in the winter months at the vehicle maintenance shop space heater. The burning of recycled waste oil is conducted consistent with the MassDEP policy for “Safe Handling of Waste Oil in Space Heaters”⁵⁵.

In October of 2011, Hanscom installed 222 PV solar panels mounted on the roof and side of the Civil Air Terminal building. The panels are located on the south facing side of the building roof including a series of wall mounted panels on the façade of the building. The system is expected to produce over 52,000 kWh of electricity per year or roughly 10 percent of the buildings annual electricity consumption.

8.5.4 Other Aviation Support Emission Reductions

On-board Auxiliary Power Units (APUs) and Ground Power Units (GPUs) provide power for avionics electricity, heat and air conditioning to an aircraft when its engines are off. Pilots of small jets run their APU (or a GPU) to heat or cool the aircraft while they wait for passengers. These aircraft operate primarily through the two FBOs at Hanscom Field: Signature and Jet Aviation. A third FBO, Rectrix is scheduled to commence operation in early 2014. APUs and GPUs produce relatively small amounts of air pollutant emissions in comparison to aircraft engines. While Massport neither owns nor directly controls the operation of these small power units, the Authority recognizes the air quality benefit of minimizing APU/GPU operations.

In the *2000 and 2005 ESPR*, Massport examined airside operations and concluded that Hanscom Field already operates without any appreciable taxiway delays that could produce excess emissions and this situation would not change even for a future planning scenario. Emissions from aircraft are exclusively within the jurisdiction of the federal government, and aircraft operations are subject to the exclusive jurisdiction of FAA controllers. One area where a few aircraft are briefly delayed on some summer days is Golf North Taxiway at Runway 23. In the *2005 ESPR*, Massport identified a potential project to install a paved aircraft holding area at the approach end of Runway 23 to reduce these minor delays. This project has not commenced construction; however, Massport is still planning to include this in a future construction project.

8.5.5 Clean Fuel Vehicle Program

Massport has made progress in bringing AFVs into its fleet at Hanscom Field. At present, Massport owns fifteen fleet vehicles at Hanscom Field, four of which are electric. Massport will continue to consider AFVs for any new vehicle purchase in the future. Also, since Massachusetts has adopted the California

⁵⁵<http://www.mass.gov/dep/recycle/laws/spacehtr.pdf>

Low Emission Vehicle program, any new conventional-fueled vehicle added to the Hanscom fleet in the future will have very low emissions and will automatically comply with the low emission goals of the federal Clean Fuel Fleet Program (40 CFR Part 88).

8.5.6 Lead Emissions

With the strengthening of the lead National Ambient Air Quality Standard (NAAQS) by EPA in October of 2008, many communities living near general aviation (GA) airports have become concerned about lead and emissions from GA aircraft using aviation gasoline (avgas). Typical avgas grade fuel used at Hanscom is of the 100 low lead (100 LL) type. 100LL is the only fuel in the US that continues to contain lead. Unlike automobiles, many older GA aircraft cannot operate using lead-free fuel and the US GA fleet contains many such aircraft.

Many of the GA airports, like Hanscom Field, use leaded aviation gasoline with limited amount of jet fuel service operations compared to larger commercial airports. Aviation gasoline is primarily used in GA aircraft with piston engines used for instructional flying, air taxi activities, and personal transportation. Lead is not used in commercial fuel such as jet fuel, the fuel utilized by most commercial aircraft. A fuel additive, tetraethyl lead (TEL) is added to piston engine aircraft to help boost avgas fuel octane, prevent knocks, and prevent valve seat recession. The resultant engine emissions from burning fuel with TEL include lead.

Based on 2013 operations at Hanscom (as of October 2013), there are a total 246 reciprocating (piston) engines requiring 100 LL fuel or 69 percent of the current based aircraft count⁵⁶. It is expected for future year operations this percentage to gradually increase, however lead emissions from the airport are expected to decline once the FAA introduces engine standards and an alternative fuel replacement.

8.5.6.1 Status of Lead NAAQS

EPA strengthened the lead NAAQS in 2008 from 1.5 ug/m³ to 0.15 ug/m³ (measured over a rolling 3-month average), finding that serious health effects occur at much lower levels in the blood stream than previously identified. Lead emissions from GA aircraft are primarily emitted into the air through aviation exhaust using avgas 100 LL, the most commonly used aviation fuel, and can enter the body through inhalation or ingested via plants, water or soil. Children are particularly vulnerable to the effects of lead and it can affect their IQ, learning, memory and behavior.

In March of 2012, the environmental group Friends of the Earth (FOE) filed a lawsuit against the EPA stating that EPA has unreasonably delayed its response to FOE's 2006 petition asking the agency to make an endangerment finding and propose standards for lead emissions of aircraft. Since the FOE 2006 petition, the EPA has promulgated new lead standards (see above) and has also mandated lead monitoring at 15 selected airports. Although initially considered by the EPA, Hanscom Field was not included in the list.⁵⁷ Nantucket Memorial Airport is the closest airport to Hanscom on the EPA list with an estimated lead emission level of 0.76 tons per year based on the 2008 National Emissions Inventory. For comparison, lead emissions at Hanscom were estimated at 0.47 tons per year (a reduction of 38 percent compared to Nantucket) based on the 2008 emission inventory. As discussed earlier, EPA and MassDEP commenced a year-long lead monitoring program at Nantucket in February of 2012. To date, the highest

⁵⁶ Information provided by Massport.

⁵⁷ <http://www.epa.gov/otaq/regs/nonroad/aviation/memo-selc-airport-mon-stdy.pdf>

reported 3-month lead concentration is 0.0209 ug/m³ and the highest 24-hour concentration is 0.04 ug/m³ well below the new standard of 0.15 ug/m³.

The EPA has summarized and made available the partial results of the monitoring data from 17 airports⁵⁸. It is anticipated that a full year of data should be available from all airports by May of 2014. Massport will update this section in the next ESPR to include the final results of the study.

As a result of the partial findings, the FAA on June 19, 2013 issued interim guidance on mitigating public risks from lead emissions associated with avgas⁵⁹. The guidance is provided for FAA identified airports of concern based on a review of the EPA partial monitoring results and for any operator concerned about lead emissions. Based on the guidance, the FAA is working with airport operators to reduce lead emissions in the short-term by:

- Promoting the use of currently available reduced lead and unleaded fuel formulations;
- Identifying and considering operational changes at the airport that could mitigate lead exposure;
- Consider implementation of vapor controls for fuel storage and dispensing stations;
- Shifting orientation of run up activities for areas where the public could be exposed to propeller wash. Move these operations to non-public locations where emissions can be better contained or minimize public exposure;
- Minimize the public outdoor exposure to lead emissions by moving fences to increase the distance from run-up areas and public observation area, and/or post signs to discourage loitering near areas where potential to exposure to lead from piston engine emissions could occur.

Hanscom is not identified as an airport of concern based on the FAA preliminary monitoring studies. In the long-term, the FAA is working with the aviation industry and EPA to develop an unleaded fuel replacement by 2018 as part of the transition from leaded avgas⁶⁰.

8.5.6.2 EPA and FAA Next Steps

In addition to FAA's efforts toward developing an alternative fuel replacement by 2018, the EPA is conducting an analysis, including modeling and monitoring to evaluate whether lead emissions from avgas could cause or contribute to air pollution which could endanger the public health and welfare. Any endangerment finding would be subject to public notice and comment, and final determination is not expected until 2015. If EPA makes an endangerment finding, the agency would establish standards for lead emissions from piston engine aircraft. FAA ultimately would develop regulations to ensure compliance with the standards and would be required to establish fuel standards to control lead emissions. Massport will provide an update in the next ESPR.

8.5.6.3 Massachusetts Ambient Lead Concentrations

There are no ambient lead monitors at or near Hanscom Field; however, MassDEP does operate monitors that measure lead in Boston and Nantucket Airport. A review of lead monitoring data from the Harrison Avenue monitor in Boston shows maximum value of 0.014 ug/m³ which is well below the new lead standard. In addition, maximum quarterly measured values of 0.02 ug/m³ at Nantucket are also well

⁵⁸<http://www.epa.gov/otaq/regs/nonroad/aviation/420f13032.pdf>

⁵⁹http://www.faa.gov/airports/environmental/policy_guidance/media/leadMitigationMemoJune2013.pdf

⁶⁰http://www.faa.gov/regulations_policies/rulemaking/committees/documents/media/Avgas.ARC.RR.2.17.12.pdf.

below the lead standard of 0.15 ug/m^3 . As discussed earlier, the 2008 National Emissions Inventory showed that lead emissions at Hanscom were 37 percent lower than Nantucket and was not identified by EPA as an airport that required mandatory lead monitoring. Future lead emissions may rise with increased operations at Hanscom but will eventually decline once the FAA introduces engine standards and an alternative fuel replacement. EPA and FAA are still reviewing the results of the airport monitoring study and Massport will provide an update in the next ESPR.

8.5.6.4 Summary of Lead Studies

The EPA and the California South Coast Air Quality Management District (SQAQMD) have conducted lead studies at Santa Monica and Van Nuys airports. These studies were reviewed and summarized to document the state of investigations and findings of public health.

The first study was conducted by EPA in 2010 near the Santa Monica airport entitled “Development and Evaluation of an Air Quality Modeling Approach for Lead Emissions from Piston-Engine Aircraft Operating on Leaded Aviation Gasoline”⁶¹. This study included both monitoring and modeling of lead emissions and showed that off property receptor (i.e. beyond the fence line) concentrations were below the lead NAAQS.

The SCAQMD conducted a study entitled “General Aviation Airport Air Monitoring Study”⁶² for the Santa Monica and Van Nuys airports. The results of the study show that lead concentrations were also below the NAAQS at sites beyond the fence line at both airports.

As stated earlier, as part of the Proposed Revision to the Lead Ambient Monitoring Requirements, EPA is conducting lead measurements at 17 selected airports including Nantucket. The EPA has summarized and made available the partial results of the monitoring data from the 17 airports and a full year of data should be available from all airports by May of 2014 and will be reported in the next ESPR.

8.5.6.5 Status of Lead Free AvGas in the US

As stated earlier, FAA is committed to developing a replacement fuel for leaded aviation gasoline by 2018. On June 10, 2013, FAA issued a request for candidate fuel producers to submit alternative fuel formulations to be evaluated as potential replacement to 100LL. This announcement is a formal request by FAA to sample candidate fuels for testing to evaluate potential fuel alternatives in order to select the best unleaded fuel with the least impact on the GA fleet. Currently there is no unleaded fuel replacement that meets the needs of the entire GA fleet. There has been some progress in developing alternatives to 100 LL, however, the alternative fuels developed to date are either still being tested or only available for specific engine types. Examples of some of the new unleaded fuel grades currently being reviewed are:

- 93UL - Airworthy AutoGas, LLC has developed an ethanol free, 93 octane premium unleaded fuel. It has been tested on the Piper Archer 180 hp Lycoming engine airplane. The 93UL is not designed to replace 100LL, but rather an alternative to certain engines that do not require 100 LL.
- 94UL is the removal of the tetraethyl lead additive completely from 100 UL which results in 94 octane fuel or 94UL. Continental Motors is modifying their engines to run on 94 UL, however, not all engine manufacturers are on board with 94UL as a viable alternative fuel. Skeptics are concerned with performance and retrofit cost and prefer continued development of 100 octane replacement fuels.

⁶¹<http://www.epa.gov/nonroad/aviation/420r10007.pdf>

⁶²http://www.aqmd.gov/tao/AQ-Reports/GA_Report.pdf

- 100SF Swift Fuels, LLC along with Purdue University is developing an alternative to 100LL by fermenting cellulose into acetone to make fuel. The product is still in the development phase; however, the fuel is designed to replace 100LL for use in both high compression and low compression engines with only minor modifications. The product is currently being tested at Embry Riddle Aeronautical University.
- G100UL General Aviation Modification Inc. (GAMI) is developing an unleaded fuel replacement to known as G100 UL (unleaded) by blending existing refinery products with an additive to recover the octane level of low lead avgas. The product is currently being tested at Embry-Riddle Aeronautical University. The company goal is to have G100 UL be a drop in fuel replacement for 100LL.

Two alternative fuels which have showed some promise in Europe are UL91 and 91/96UL. UL 91 is gaining some support in Europe, but its use is limited to engines approved to operate on automotive specific fuels. UL91 is not a replacement to 100LL, but is an alternative to automotive gasoline and is available in the United Kingdom, France and Switzerland. Wider support has centered around Swedish oil refiner, Hjelmcö Oil. Hjelmcö has developed avgas 91/96UL avgas which contains no lead and was approved for use by the European Aviation Safety Agency (EASA) in 2010 where the engine manufacturer has approved the use of the fuel. The company's website claims that 90 % of the entire piston powered General Aviation fleet of the world is certified to use Hjelmcö AVGAS 91/96 UL⁶³.

Applications in the U.S. could be difficult since there is a large number of high performance aircraft that utilize the majority of 100LL avgas and could not operate on 91/96 UL without modifications.

Canada is also looking into 100 LL avgas alternatives. On June 17, 2013, the National Research Council Canada (NRC) commenced efforts to assist in the development of and test potential 100 LL alternatives. Currently two lower lead octane certified fuels are available for use in Canada, however, they are not a viable alternative to 100 LL.

8.5.7 Ultrafine Particulate (UFP) Matter

Ultrafine particles (UFP) are defined as particle sizes less than 0.1 microns in diameter. To date, there are no EPA or MassDEP air quality regulations that exist for UFP due to limited health studies to substantiate an air quality standard. For perspective, EPA and MassDEP currently have ambient standards for inhalable coarse particles and fine particles. Inhalable coarse particles are defined as particles smaller than 10 micron and larger than 2.5 microns in diameter (PM₁₀) and are found near roadways and dusty industries⁶⁴. Fine particles are particles that are 2.5 microns in diameter and smaller (PM_{2.5}) and are directly emitted from sources such as forest fires, or can form when gases emitted from power plants, industries, and automobiles react in air.⁶⁵

The primary sources of UFP are from the combustion process, manufacturing process, secondary atmospheric transformation, or occur naturally in the environment. For perspective, aircraft emissions are one of many potential sources of UFP sources in the region around Hanscom along with vehicle traffic energy generation, and manufacturing processes. However, in urban areas, particularly in proximity to major roads, motor vehicle exhaust is often identified as the major contributor to UFP concentrations.

⁶³ http://www.hjelmco.com/pages.asp?r_id=13395

⁶⁴ EPA <http://www.epa.gov/air/particlepollution/>

⁶⁵ EPA <http://www.epa.gov/air/particlepollution/>

Diesel vehicles have been found to contribute substantially, sometimes in disproportion to their numbers in the vehicle fleet.⁶⁶

There are relatively few reports published on the health effects of UFPs, however, it is generally understood that smaller particles which are inhaled into the lungs pose a greater health risk impact compared to larger particles. Therefore, there is growing need to gather more information on UFPs and their potential health effects.

The Los Angeles World Airports (LAWA) recently released an Air Quality and Source Apportionment Study (June 18, 2013) which measured pollutant concentrations in the vicinity of LAX to assess potential airport-related contribution of emissions on the ambient air quality around the airport. Included in the study was measurement of number concentrations, used to estimate UFP emissions, to examine the chemical nature in jet exhaust and source contributions of UFP in the communities east of LAX. The study found higher concentrations east of the airport when compared to other locations in the South Coast air basin. In addition, the study found that small UFP particles were mainly attributed to sulfuric acid aerosol from jet exhaust, while the larger UFP particles appeared to be related to vehicle exhaust from local traffic. Future health impact studies from airport related sources will need to consider the UFP sizes and effects from jet and vehicle exhaust.

In addition to the LAWA study, the Transportation Research Board under the Airports Cooperative Research Program (ACRP) has conducted or is in the process of conducting research in the UFP and particulate matter area. Relevant studies pertaining to particulate matter and aviation are ACRP Report 6 “Research Needs Associated with Particulates at Airports” and Report 9 “Summarizing and Interpreting Aircraft Gaseous and Particulate Emissions Data”. Ongoing studies include Project 02-42 “Understanding Air Quality and Public Health Studies Related to Airports”. The next ESPR will provide an update on these ongoing studies.

⁶⁶ Understanding the Health Effects of Ambient Ultrafine Particles, Health Effects Institute, 2013.
<http://pubs.healtheffects.org/getfile.php?u=893>

9 Wetlands/Wildlife/Water Resources

This chapter provides information about wetlands, wildlife and water resources. The information establishes year 2012 conditions by reporting data from various sources that include the 1998 Hanscom Field Wetlands Delineation Location Map and updates, the 2004- 2008 and 2009-2013 Hanscom Field Vegetation Management Plan (VMP), the Massachusetts Natural Heritage and Endangered Species Program's (NHESP) current inventory of rare species, and reports to the National Wildlife Strikes Database. This section reports on the status of the VMP, the Stormwater Pollution Prevention Plan (SWPPP), the Shawsheen River water quality monitoring program and the 2009 National Pollutant Discharge Elimination System (NPDES) permit that includes nine Hanscom Field tenants.

9.1 Changes Since 2005

Wetlands, wildlife and water resource areas at Hanscom Field are fundamentally unchanged from the 2005 *ESPR*. New wetland resource areas have been delineated in areas where new development projects have been planned and implemented. The NHESP has indicated that four species listed under the Massachusetts Endangered Species Act have been found on Hanscom property including Blanding's and Wood Turtle, which have been identified since 2005.

In 2004, Massport implemented the VMP to address the goals of aviation safety and natural resource management, which required some vegetation removal to remove obstructions to airspace. Since then, the VMP was updated in 2008 to maintain the goals of the first Five Year VMP. Massport is currently revising the VMP which is not required until 2016 due to the enactment of the Massachusetts Permit Extension Act of 2010.

The concept plans for potential future development in the 2020 and 2030 scenarios presented in Chapter 4, Airport Planning, have the potential to affect wetland resources but not protected species habitat or vernal pools. Specifically, wetlands recently delineated in the Terminal Area as part of the Jet Aviation Hangar Project would be adjacent to a new access road between the Terminal access road and the West Ramp. Also, potential development projects (the Air and Space Museum, and a hotel) on either side of the Terminal Access road would be sited near wetlands. In addition, an access road from Hartwell Avenue to the East Ramp which was part of the 2005 *ESPR* and remains an option would likely intersect with the Riverfront Area associated with the Shawsheen River. In all cases, future development proposals would need to be reviewed for compliance with the Massachusetts Wetlands Protection Act and its implementing regulations including compliance with the stormwater management regulations.

Massport continues to implement its Spill Prevention Control and Countermeasure (SPCC) Plan and maintains contracts with emergency response cleanup contractors to respond to Massport or tenant spill events. The "State of Hanscom" reports indicate that there has been one spill at Hanscom Field since 2005; however, Massport was not responsible for this spill. The spill was reported to Massachusetts Department of Environmental Protection (MassDEP) and appropriate measures were taken to protect the environment. During 2003 and 2004, Massport conducted a deicing study and monitoring effort at Hanscom Field. That study showed that neither current nor future scenario deicing efforts at Hanscom

will adversely affect the water supply for Bedford, Burlington or any other nearby communities. Hanscom does not use more than 100,000 gallons of deicing fluid on an average annual basis, and is therefore not subject to benchmark monitoring that is typically required as part of the National Pollutant Discharge Elimination System (NPDES) Multi-Sector General Permit (see Runway Deicing section for more details). Since future scenario deicing efforts are not expected to change, the conclusion of no adverse outcomes remains.

9.2 Year 2012 Conditions

The following sections describe the existing Hanscom Field environment in terms of geographic and geologic characteristics, wetlands and surface water features, wildlife habitat, rare and endangered species, and groundwater. It also describes Massport's efforts to maintain and improve the quality of stormwater runoff from the site. In addition, an update on the environmental auditing programs, MassDEP-listed sites, and the Hanscom Air Force Base (AFB) environmental restoration program is provided.

9.3 Geographic and Geologic Characteristics

A general discussion of the geographic and geologic characteristics is provided below.

9.3.1.1 Geography and Topography

Hanscom Field is situated in the Eastern Plateau Physiographic Region, a low-lying and well-dissected region of eastern Massachusetts. Primary drainage for this region is provided by the Merrimack, Parker, Rowley, Ipswich, Concord, Sudbury, Assabet, Charles and Neponset Rivers. The United States Geological Survey (USGS) maps the elevation of Hanscom Field ranging from a high of about 250 feet above mean sea level (AMSL) just west of the airfield to a low of approximately 118 feet AMSL east of the runways, with the majority of the study area below 150 feet AMSL.

9.3.1.2 Geology and Soils

Hanscom Field is underlain by a complex assortment of Pleistocene Epoch glacial and recent deposits that overlay Silurian and Ordovician Period igneous and metamorphic bedrock. Repeated advances and retreats of continental glaciers removed the pre-glacial deposits, shaped the bedrock, and deposited unconsolidated material in the form of glacial till and outwash deposits. Following retreat of the last glacier approximately 13,000 years ago, peat was deposited in wetland areas, and fill material was added during the development of the airfield in the last century.

Native soils within the perimeters of Hanscom Field have been disrupted by construction and associated earth-moving activities. The Soil Conservation Service has classified most of the soils on the airfield as "made land". The existing soils are generally a mixture of native soils, and their physical and chemical properties resemble the undisturbed soils.

9.4 Wetlands

The following section describes the current status of the state and federally-protected wetland resource areas at Hanscom Field in the towns of Bedford, Concord, Lexington, and Lincoln. Descriptions of wetland resource types and the criteria for their identification follow. Descriptions of the individual Hanscom Field wetland area's vegetation, soils, and hydrology are presented in Table 9-1. Wetland areas

are depicted in Figure 9-1. This information was derived from a review of existing documents including the 2005 *ESPR*, wetland delineations performed for the 2004-2008 Hanscom Field Vegetation Management Plan, and wetland delineations performed in 2010 and 2012 in association with onsite activities.

Table 9-1 Description of Wetland Resources

2002-2006 Hanscom Field Vegetation Management Plan, 2013 Jet Aviation Draft Environmental Assessment

Wetland I.D.	Resource Areas ¹	Wetland Type ²	Soil Type ³	Notes
1-1	BVW, Bank, LUWB, Riverfront	PFO1, PSS, R3	Saco	This wetland complex is comprised of forested and scrub/shrub wetland types with several channelized drainage swales. Dominant species include red maple, trembling aspen, glossy buckthorn, highbush blueberry, silky dogwood, speckled alder, and cinnamon fern.
1-2	BVW, Bank	PFO1, PSS1, R4, PEM	Scarboro, Freetown	This wetland complex is primarily a red maple swamp with scrub/shrub and emergent portions. Dominant vegetation includes red maple, highbush blueberry, glossy buckthorn, tussock sedge, soft rush, and Sphagnum. Beaver activity has flooded a portion of this wetland.
1-3	Non-Jurisdictional	PSS1	Udorthents-Sandy	This scrub/shrub wetland wraps around the end of Runway 23. It is disturbed, isolated, and presumed to be non-jurisdictional under the Massachusetts WPA. The dominant shrubs in the wetland are speckled alder and elderberry.
1-4	BVW, Bank	PFO1, PSS1, PEM1	Scarboro, Udorthents-Sandy	Wetland 1-4 is a detention basin that borders on a larger red maple swamp.
1-5	Non-Jurisdictional	PSS1	Udorthents-Sandy	This wetland is a relatively small isolated depression within a mowed area. It is not a state jurisdictional area.
2-1	BVW, Bank, LUWB, Riverfront	PFO1, PSS1, PEM1, R3, R4,	Freetown, Wareham, Scarboro, Swansea	This wetland complex is associated with Elm Brook. It contains forested, scrub/shrub and emergent wetland types. Dominant species include red maple, highbush blueberry, glossy buckthorn, northern arrowwood, woolgrass, tussock sedge, soft rush, and Sphagnum.
2-2	Non-Jurisdictional	PSS1, PEM1	Udorthents-Sandy	Not a state-jurisdictional wetland area.
2-3	Non-Jurisdictional	PUB3	Deerfield	This is an isolated non-jurisdictional wetland area with limited wetland vegetation. This area was previously identified in the 1995 <i>GEIR</i> and 2000 <i>ESPR</i> as a possible vernal pool.
2-4	Certified Vernal Pools	PSS1, PUB, PEM1	Windsor, Deerfield	This wetland area is composed of several isolated wetlands apparently formed within depressions created by past earth moving activities. They are scrub/shrub and emergent wetlands dominated by willow, silky dogwood, purple loosestrife, and sensitive fern. According the Massachusetts Natural Heritage Atlas 13 th edition, this area contains two certified vernal pools.
2-5	Certified Vernal Pool	PSS1	Deerfield	This isolated wetland area is also apparently formed in a man-made depression and contains purple loosestrife and Sphagnum. According the Massachusetts Natural Heritage Atlas, this area has been certified as a vernal pool.
2-6	Non-Jurisdictional	PSS1	Deerfield	This isolated wetland has possibly formed in a manmade depression in a disturbed area. It is a forested and scrub/shrub wetland type dominated by red maple, American elm, glossy buckthorn, silky dogwood, arrowwood, and multiflora rose.
2-7	Non-Jurisdictional	PFO1	Scarboro	This isolated wetland has possibly formed in a manmade depression in a disturbed area. It is a forested and scrub/shrub wetland type dominated by red maple, American elm, glossy buckthorn, silky dogwood, arrowwood, and multiflora rose.

Wetland I.D.	Resource Areas ¹	Wetland Type ²	Soil Type ³	Notes
2-8	BVW	PFO1, PSS1, PEM1,	Scarboro	This wetland is a red maple swamp that also contains portions of scrub/shrub wetland and emergent wetland. It receives road drainage from Old Bedford Road.
2-9	Bank	R4	Udorthents-Loamy	This area is an open drainage ditch that outlets to Elm Brook.
3-1	ILSF possible	PFO1	Canton	With the exception of wetland areas 3-5, areas 3-1 through 3-7 all appear to be man-made either inadvertently or for stormwater management purposes. Wetland 3-5 appears to be relatively undisturbed forested wetland dominated by red maple, trembling aspen, and winterberry. Wetlands 3- 1, 3-2, 3-4, and 3-6 are forested and scrub/shrub wetlands with small emergent areas. Dominant species in the forested and scrub/shrub areas include red maple, glossy buckthorn, gray birch, trembling aspen, speckled alder, and cinnamon fern. Wetlands 3-3 and 3-7 are vegetated swales dominated by emergent species such as cattail and purple loosestrife.
3-2	Non-Jurisdictional	PFO1	Canton	
3-3	Non-Jurisdictional	PEM1	Canton	
3-4	Non-Jurisdictional	PSS1, PEM1, PUB	Canton	
3-5	Non-Jurisdictional	PFO1	Canton	
3-6	BVW, Bank	PFO1	Canton	
3-7	BVW	PEM1, PSS1	Canton	
3-8	BVW, Bank, BLSF	PFO1, PSS1, PEM1, R4	Freetown, Wareham, Deerfield, Birdsall	This relatively large and undisturbed wetland complex consists of forested, scrub/shrub, and emergent communities. It is also within the Elm Brook floodplain. Forested red maple swamp with a glossy buckthorn understory is the dominant type of wetland in this complex. Portions of the complex also include purple loosestrife dominated marsh and farmed areas.
Wetland No. 1	BVW	PEM1	Canton	This wetland consists of an emergent plant community, with a large number of soft rush present. Hydric soils are present with abundantly mottled and saturated at the surface, with some standing water.
Wetland No. 2	BVW	PSS1, PEM1, PFO1	Canton	This wetland contains forested, scrub/shrub and emergent wetlands. It is located south of Wetland 3-9 but is not connected to it. The most abundant canopy species includes red maple and cottonwood. The most common understory species includes alder, pussy willow, oriental bittersweet, jewel weed, and cattail. Within a portion of this wetland, the characteristics of a certified vernal pool have been observed. To date the pool has not been certified by the Massachusetts Natural Heritage and Endangered Species Program.
Wetland No. 3	BVW	PFO 1	Canton	This wetland is primarily forested and drains in a westerly direction to the drainage channel adjacent to the existing T hangars. Dominant canopy species include red maple and yellow birch, while understory species consist of arrowwood, spicebush, skunk cabbage, and sensitive fern. Within a portion of this wetland, the characteristics of a certified vernal pool have been observed. To date the pool has not been certified by the Massachusetts Natural Heritage and Endangered Species Program.
Wetland No. 4	BVW	PSS 1 PEM 1	Canton	This wetland is primarily scrub/shrub and emergent wetland. Dominant species include pussy willow, blue vervain, woll grass, and tussock sedge. Groundwater and surface runoff flow in the direction of the drainage channel adjacent to the existing T-hangars.

Wetland I.D.	Resource Areas ¹	Wetland Type ²	Soil Type ³	Notes
Notes: 1. Massachusetts WPA Resource Areas (310 CMR 10.00): RA 200 Foot Riverfront Area BVW Bordering Vegetated Wetland Bank Bank (Land which abuts and confines a water body) LUWB Land Under Water Bodies Waterways ILSF Isolated Land Subject to Flooding Isolated Wetland is hydrologically isolated (Not a Massachusetts WPA Resource Area) 2. Wetland Type (Cowardin et al, 1977) PFO 1 Palustrine Forested/Broad-Leaved Deciduous PFO 4 Palustrine Forested/Needle-Leaved Evergreen PSS 1 Palustrine Scrub-Shrub/Broad-Leaved Deciduous PEM 1 Palustrine Emergent/Persistent PUB Palustrine Unconsolidated Bottom (unvegetated wetland) R3 Riverine (perennial) R4 Riverine (intermittent) B Beaver influence 3. Soil series Mapped by USDA SCS (Middlesex Conservation District, 1986)				

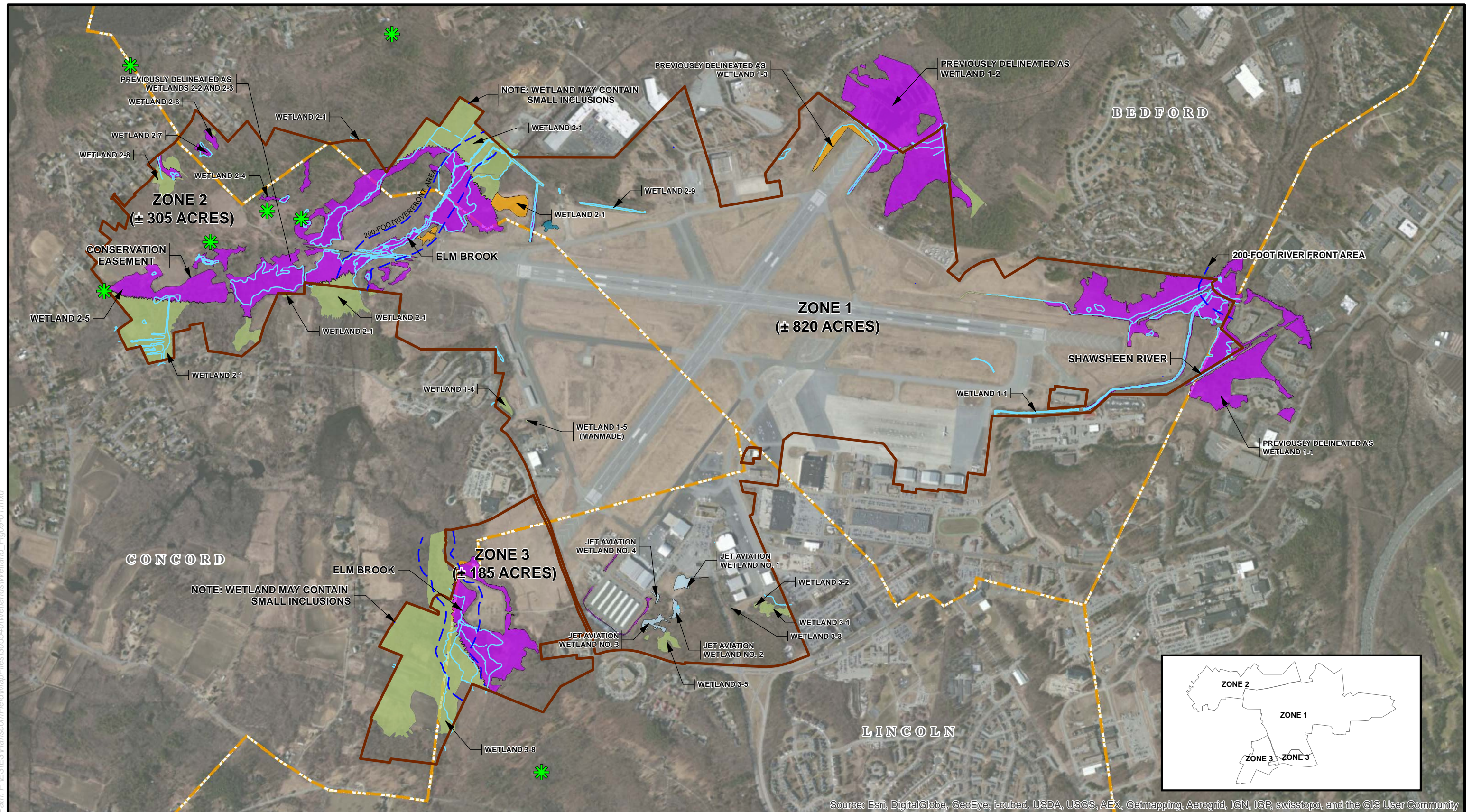
The wetland resources at Hanscom Field were delineated and described in the 1998 Hanscom Field Wetlands Delineation Location Map (“1998 Wetlands Map”) that was presented in the 2005 *ESPR*. This delineation effort included all of the Hanscom Field property except land within runway and taxiway areas. The wetlands within the vegetation management areas were delineated in August of 2001 for the 2004-2008 Hanscom Field Vegetation Management Plan (VMP). The delineated wetland boundaries within the vegetation management areas were certified by the conservation commissions of the respective towns in December 2001 through the MassDEP’s Abbreviated Notice of Resource Area Delineation (ANRAD) process.

Three wetland delineation surveys have been completed and documented as part of the VMP. The revised boundaries are shown in Figure 9-1 along with labels for the original wetland ID given for the VMP. Except where noted, the descriptions provided in Table 9-1 remain applicable to the updated wetlands. For the most recent wetland survey completed in October 2012, updated information is provided in Table 9-1. The jurisdictional determination for four newly delineated bordering vegetated wetlands (wetlands No. 1 through No. 4) were approved by the Lincoln Conservation Commission through an ANRAD. Previously delineated wetlands (3-4 and 3-5) in proximity to these four wetlands were considered non-jurisdictional and should be revisited if any development or other activity is proposed within their boundaries.

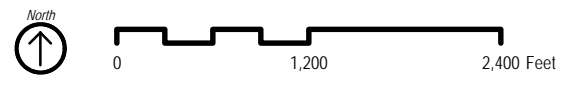
The boundaries and regulatory status of the wetlands beyond the vegetation management areas would be subject to review and approval by the applicable conservation commission(s) through the submission of appropriate applications under the Massachusetts Wetlands Protection Act (WPA) for any future proposed work within a jurisdictional area. Since the VMP delineations, three additional areas have undergone this process as indicated in Figure 9-1. Any wetland permits issued between August 15, 2008 and August 15, 2012 receive an automatic four year extension under the Massachusetts Permit Extension Act passed by the State legislature to mitigate for the effects of the economic recession.

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Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



Legend

- | | |
|------------------------------------|--------------------------|
| Wetlands Designated 1998 | Town Boundary |
| Wetlands (H153-C1, Feb. 2010) | Property Line |
| Wetlands (H212-C1, Apr. 2010) | Certified Vernal Pool |
| Wetlands (H234-C1, March 2012) | 200-foot Riverfront Area |
| Wetlands (Jet Aviation, Oct. 2012) | Hydrology |

NOTES:

1. This drawing is intended for conceptual planning purposes only. It may not be used without the express written permission of the Massachusetts Port Authority ("Massport"). Massport does not certify the accuracy, information or title to the properties contained in this plan nor make any warranties of any kind, express or implied, in fact or by law, with respect to any boundaries, easement, restrictions, claims, overlaps or other encumbrances affecting such properties.
2. Characteristics of a certified vernal pool have been observed in Wetland No. 2 and No. 3 by Jet Aviation; to date have not been certified by Massachusetts Natural Heritage and Endangered Species Program.



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Wetlands Location Map
October 2012

Data Sources: ESRI (USGS Topographic Maps), March 4, 2013; MassGIS (Community Boundaries), March 5, 2013

Figure 9-1

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The wetland resource areas at Hanscom Field include wetlands subject to regulation by both the Commonwealth of Massachusetts and U.S. Army Corps of Engineers (USACE). The regulations of the Massachusetts WPA (310 CMR 10.00 et seq.) define five freshwater wetland resource areas subject to protection: Banks, Bordering Vegetated Wetlands, Land Under Waterbodies/Waterways, Bordering/Isolated Land Subject to Flooding, and Riverfront Area. Each of these resource area types is defined as follows:

- **Banks** are land areas that normally abut and confine a water body. Banks occur between a waterbody and a vegetated wetland or adjacent floodplain, or between a waterbody and an upland.
- **Bordering Vegetated Wetlands (BVW)** include those vegetated freshwater wetlands that border on water bodies and waterways. The technical criteria and methodology utilized to identify and delineate BVW is set forth in Delineating Bordering Vegetated Wetlands under the Massachusetts Wetlands Protection Act (DEP, 1995). Criteria for identifying and delineating this resource area include the presence of a plant community dominated by wetland indicator species, and signs of hydrology. The presence of hydric soils within the wetland is considered an indicator of hydrology.
- **Land Under Water Bodies/Waterways (LUWB)** is the land area under any creek, river, stream, pond, or lake and is a resource area subject to protection under the Massachusetts WPA.
- **Bordering Land Subject to Flooding (BLSF)** is an area with low, flat topography adjacent to and inundated by flood waters rising from creeks, rivers, streams, ponds or lakes. BLSF extends from the banks of these waterways and water bodies; where a bordering vegetated wetland occurs, it extends from said wetland. BLSF boundaries are the maximum lateral extent of floodwater, which will theoretically result from the statistical 100-year storm. The extent of Bordering Land Subject to Flooding is typically derived from examining FEMA Flood Insurance Rate Maps.
- **Isolated Land Subject to Flooding (ILSF)** are isolated depressions or closed basins without an inlet or outlet. It is an area which, at least once per year, confines standing water to a volume of at least one-quarter acre-feet and an average depth of at least six inches.
- **Riverfront Area** is land between a perennial river's mean annual high-water line and a parallel line located 200 feet away, measured horizontally outward from the river's mean annual high-water line. The perennial status of a waterway is generally determined by examination of the USGS topographic map.

A 100-foot buffer zone is associated with regulated Bank and Bordering Vegetated Wetland.

The USACE regulations that accompany the Federal Clean Water Act [33 CFR Parts 321-330 (November 12, 1986)] define waters of the United States as aquatic habitats that include open water areas and wetlands. Wetlands are further defined as those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support and that under normal circumstances do support a prevalence of vegetation typically adapted for life in saturated soil conditions.

Wetlands generally include swamps, marshes, bogs, and similar areas [33 CFR 328.3(b)]. This definition emphasizes a wetland's attributes of hydrophytic vegetation, hydric soils, and hydrology. Pursuant to the USACE Wetlands Delineation Manual (Environmental Laboratory, 1987) (the Manual), the mandatory technical criteria that characterize these parameters are outlined as follows:

- **Hydrophytic Vegetation:** The predominant vegetation consists of macrophytes, which typically grow in soils that are periodically deficient in oxygen as a result of excessive water content. The U.S. Fish and Wildlife Service (USFWS) publication, "National List of Plant Species that Occur in

Wetlands: Northeast (Region 1)” (Reed, 1988) and its 1995 supplement, were used to classify plant species according to their frequency of occurrence in wetlands.

- **Hydric Soils:** These are soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions (typified by thick organic surface layers, gleying, or mottles) within a depth of 18 inches.
- **Hydrology:** This addresses areas that are saturated to the surface or inundated at some time during the growing season of the prevalent vegetation. Typical indicators include surface-scoured areas and water-stained leaves.

Based on a review of the existing site and relevant information, the current status of the wetland resource areas at Hanscom Field is relatively unchanged from those identified in the 2005 *ESPR*. A description of the vegetation, soils, hydrology, and presumed values of these areas is provided in Table 9-1 (Large wetland complexes are described as single wetlands on the figure and in the table.).

9.5 Vernal Pools

Three vernal pools have been certified at Hanscom Field by the NHESP. These three vernal pools (within Wetlands 2-4 and 2-5), all of which are located within the town of Concord to the west of Runway 11-29, are shown on Figure 9-1. A fourth area with potential vernal pool characteristics occurs within Wetland 2-3 in the same vicinity as the three certified vernal pools in Concord. During 2012 wetland delineations, characteristics of certified vernal pools were identified in wetlands No. 3 and No. 4. However, to date these areas have not been certified by the NHESP. A plan to protect the certified vernal pools during vegetation management operations was developed as part of the current Hanscom Field VMP.

9.6 Perennial Streams

Two perennial waterways exist at Hanscom Field: the Shawsheen River in Bedford and Elm Brook in Bedford, Concord, and Lincoln. The USGS topographic map (Maynard Quadrangle, 1987) indicates that both the Shawsheen River and Elm Brook are perennial waterways. Elm brook is tributary of the Shawsheen River meaning it flow into the Shawsheen. Additionally, the Massachusetts WPA specifically states that the entire length of the Shawsheen River, a major river, has an associated Riverfront Area. As such, both the Shawsheen River and Elm Brook have a 200-foot wide Riverfront Area extending landward from each Bank within which work is subject to regulation under the Massachusetts WPA.

9.7 Vegetation and Wildlife

Native vegetation in the vicinity of Hanscom Field is composed of a mixture of hardwood-forested uplands and wetlands with scattered softwoods, upland and wetland shrub stands, and mowed grasslands. Wetlands including forested swamps, shrub swamps, emergent marshes, and streams are situated around much of the perimeter of Hanscom Field. The airport infield areas are grasslands mowed to maintain visibility for operational safety.

The variety of vegetative cover types, presence of wetlands and waterways, and undeveloped parcels on and in the vicinity of Hanscom Field provide potential habitat for wildlife species capable of coexisting with human activities and development. Wildlife that may be expected to inhabit the area includes larger mammals such as whitetail deer and red fox, and smaller mammals such as gray squirrel and various species of mice, voles, and shrews.

Bird species that would typically populate such habitat include various insectivorous and seed-eating passerines, ground-oriented species such as woodcock, and predators such as hawks. Various reptiles and amphibians may be expected to occupy portions of the property as well. Perennial streams (Elm Brook, Shawsheen River) around the periphery of Hanscom Field are Class B surface waters according to Massachusetts Surface Water Quality Standards (314 CMR 4.06), suitable as "habitat for fish, other aquatic life, and wildlife, and for primary and secondary contact recreation" [314 CMR 4.05 (3)(b)].

9.7.1 Rare and Endangered Species

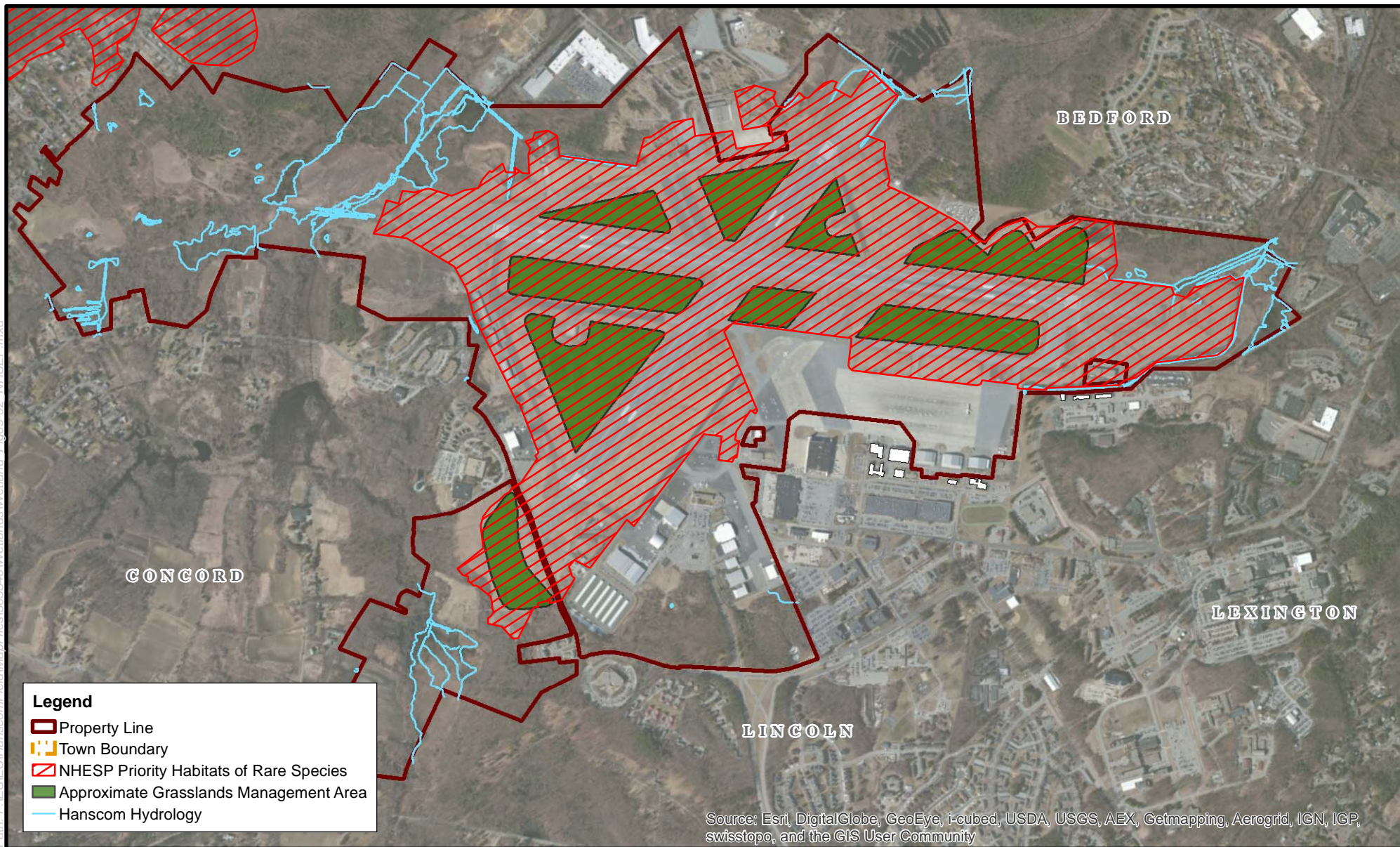
Portions of Hanscom Field are situated within an area identified in the NHESP as a Priority Habitat of Rare Species and are shown on Figure 9-2. Pursuant to the Massachusetts Endangered Species Act (M.G.L. Ch. 131A) and implementing regulations (321 CMR 10.05), all state agencies are required to "review, evaluate, and determine the impact to endangered, threatened, or special concern species or their habitats for all works, project, or activities conducted by them."

Work within mapped Estimated Habitat of Rare Species (a subset of Priority Habitat within the jurisdiction of the WPA) or certified vernal pools would need to be reviewed by the NHESP through the submission of a copy of a Notice of Intent prepared as part of the WPA filing process for work in or near wetlands.

The implementing regulations for the Massachusetts Endangered Species Act define three categories of species [321 CMR 10.03(6)]:

- **Endangered:** "any species of plant or animal in danger of extinction throughout all or a significant portion of its range, and species of plants or animals in danger of extirpation as documented by biological research and inventory."
- **Threatened:** "any species of plant or animal likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range, and any species declining or rare as determined by biological research and inventory and likely to become endangered in the foreseeable future."
- **Special Concern:** "any species of plant or animal which has been documented by biological research and inventory to have suffered a decline that could threaten the species if allowed to continue unchecked or that occurs in such small numbers or with such a restricted distribution or specialized habitat requirements that it could easily become threatened within Massachusetts."

The NHESP was contacted to obtain updated information on known occurrences of rare or endangered species of wildlife at Hanscom Field. Known occurrences of two birds (Upland Sandpiper and Grasshopper Sparrow) have remained the same since the 2000 *ESPR*. Since the 2005 *ESPR*, two additional species (Blanding's Turtle and Wood Turtle) have been observed at Hanscom Field. As listed in Table 9-2, these four species identified as endangered or threatened, have been observed at Hanscom by the NHESP or others (Appendix F).



0 1,800 3,600 Feet



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Massachusetts Natural Heritage and
Endangered Species Program Priority Habitat
at Hanscom Field

Table 9-2 Endangered, Threatened, or Special Concern Species at Hanscom Field

Common Name	Latin Name	Status ¹
Upland Sandpiper	<i>Bartramia longicauda</i>	Endangered
Grasshopper Sparrow	<i>Ammodramus savannarum</i>	Threatened
Blanding's Turtle	<i>Emydoidea blandingii</i>	Threatened
Wood Turtle	<i>Glyptemys insulpta</i>	Special Concern
Notes: 1. In accordance with the Massachusetts Endangered Species Act (M.G.L. Ch. 131A) and regulations (321 CMR 10.03)		

Source: Natural Heritage and Endangered Species Program, January 31, 2013 letter

The upland sandpiper and grasshopper sparrow have previously been observed within several areas of maintained grassland vegetation between runways and taxiways at Hanscom Field. The specific locations of nesting pairs of these species have varied somewhat over the years based on previous Massachusetts Audubon Society observations at Hanscom Field.

Fact sheets for all four species obtained from the NHESP are included in Appendix F. As the fact sheets note, both bird species require grassland habitat (e.g. hayfields and pastures), such as those found adjacent to airfields. The Blanding's Turtle requires a variety of wetland and terrestrial habitat, including marshes, scrub-shrub wetlands, and open uplands. The Wood Turtle requires riparian areas, such as stream bottoms and banks. During the spring and summer, Wood Turtles will spend time in mixed or deciduous forests, fields, and wet meadows. During the 2005 *ESPR* planning, the NHESP also confirmed that three species of Special Concern occupy habitat near, but not on, Hanscom Field.

As part of its commitment to help protect the Upland Sandpiper and other listed grassland species, Massport completed a Grassland Management Program in 2004 that also minimizes risks associated with wildlife species that can create hazards when they are on the airfield. Massport continues to follow the guidelines of the Grassland Management Program, which is included in Appendix F. Figure 9-1, depicts the approximate grassland management areas at Hanscom Field.

9.7.2 Other Species of Concern

In the past, there have been observations of other grassland bird species of interest at Hanscom Field including American kestrel, bobolink, and eastern meadowlark.

The shrub stands at Hanscom Field provide habitat for five bird species with declining populations, presented in Table 9-3. While Massport understands the value of habitat protection under federal law, the airport's primary responsibility is to maintain aviation safety. When habitat management can be implemented in compliance with federal safety standards, Massport will continue to strive to achieve balance between those objectives.

Table 9-3 Bird Species Inhabiting Shrub Stands at Hanscom Field

Common Name	Latin Name
Field Sparrow	<i>Spizella pusilla</i>
Brown Thrasher	<i>Toxostoma rufum</i>
Prairie Warbler	<i>Dendroica discolor</i>
Indigo Bunting	<i>Passerina cyanea</i>
Blue-winged Warbler	<i>Vermivora pinus</i>

Source: Massachusetts Audubon Society, 2000 *ESPR*

9.7.3 Wildlife Hazards to Aircraft

Massport must balance the maintenance of wildlife habitat with protection of public safety. In response to increasing concern about the risk posed to aircraft from certain of wildlife species, the FAA issued an Advisory Circular on Hazardous Wildlife Attractants on or near Airports (AC 150/5200-33B) to provide guidance on land uses that have the potential to attract hazardous wildlife. [A revision “33C” is currently in draft form.] The FAA also maintains a wildlife strikes database and provides guidance to pilots on reporting strikes to gather more information about the number of strikes and species that pose the greatest risk to life and property.

The National Wildlife Strike Database is also a source of information for wildlife that occurs at particular airports. Table 9-4 provides a list of wildlife strikes that have been reported at Hanscom Field between September 1990 and June 2013. 154 strikes have been recorded during that time though not all strikes include a confirmed wildlife species.

Table 9-4 Species Reported in the National Wildlife Strike Database at Hanscom Field (1990-2013)

Common Name	Scientific Name	Animal Type	Number of Strikes
American Crow	<i>Corvus brachyrhynchos</i>	Bird	1
American golden-plover	<i>Pluvialis dominica</i>	Bird	1
American kestrel	<i>Falco sparverius</i>	Bird	14
Bank swallow	<i>Riparia riparia</i>	Bird	1
Barn swallow	<i>Hirundo rustica</i>	Bird	10
Big brown bat	<i>Eptesicus fuscus</i>	Bat	1
Black-bellied plover	<i>Pluvialis squatarola</i>	Bird	1
Black poll warbler	<i>Dendroica striata</i>	Bird	1
Bobolink	<i>Dolichonyx oryzivorus</i>	Bird	2
Canada goose	<i>Branta canadensis</i>	Bird	3
Cedar waxwing	<i>Bombycilla cedrorum</i>	Bird	1
Chimney swift	<i>Chaetura pelagica</i>	Bird	3
Coyote	<i>Canis latrans</i>	Mammal	1
Crows	<i>Corvus</i>	Bird	2
Dark-eyed junco	<i>Junco hyemalis</i>	Bird	1
Ducks	<i>Anatidae (Family)</i>	Bird	5
Eastern meadowlark	<i>Sturnella magna</i>	Bird	3
European starling	<i>Sturnus vulgaris</i>	Bird	10
Geese	<i>Anatidae (family)</i>	Bird	1
Great horned-owl	<i>Bubo virginianus</i>	Bird	2
Gulls	<i>Laridae (family)</i>	Bird	8
Gulls/terns/kittiwakes	<i>Laridae/Sternidae /Laridae (family)</i>	Bird	1
Hawks	<i>Buteo sp., Accipiter sp.</i>	Bird	3
Horned lark	<i>Eremophila alpestris</i>	Bird	1
Killdeer	<i>Charadrius vociferous</i>	Bird	2
Mallard duck	<i>Anas platyrhynchos</i>	Bird	1
Mourning dove	<i>Zenaidura macroura</i>	Bird	5
Peregrine falcon	<i>Falco peregrinus</i>	Bird	1
Red tailed hawk	<i>Buteo jamaicensis</i>	Bird	3
Ring-billed gull	<i>Larus delawarensis</i>	Bird	1
Sandpipers	<i>Scolopacidae (family)</i>	Bird	1
Savannah sparrow	<i>Passerculus sandwichensis</i>	Bird	1
Snow bunting	<i>Plectrophenax nivalis</i>	Bird	2
Sparrows	<i>Passeridae (family)</i>	Bird	2
Striped skunk	<i>Mephitis mephitis</i>	Mammal	1
Swainsons thrush	<i>Catharus ustulatus</i>	Bird	1
Swallows	<i>Hirundinidae (family)</i>	Bird	3
Tree swallow	<i>Tachycineta bicolor</i>	Bird	8
Turkey vulture	<i>Cathartes aura</i>	Bird	1

Common Name	Scientific Name	Animal Type	Number of Strikes
Unknown bird or bat	--	Bird or bat	3
Unknown bird - large	--	Bird	2
Unknown bird - medium	--	Bird	12
Unknown bird - small	--	Bird	27

Source: National Wildlife Strike Database, 2013

9.8 Status of Vegetation Management Plan

Massport developed a comprehensive VMP in 2004, which was updated in 2008, in order to comply with FAA regulations and Massachusetts General Laws regarding protected airspace. The next update is subject to the Massachusetts Permit Extension Act and therefore is not required until 2016. The 2008 update will serve as a guide for current and future vegetation removal projects conducted at the airport through 2016. Notices of Intent (NOIs) were submitted to the Conservation Commissions of Bedford, Concord, Lexington and Lincoln under the limited project provisions of the Massachusetts WPA for airport vegetation removal [310 CMR 10.53(n)]. The NOIs were for Phase 1 of the 2004 and the 2009 VMP updates. They clearly described the elements of the VMP and proposed mitigation.

Massport received Orders of Conditions from the Bedford, Concord, Lexington, and Lincoln Conservation Commissions. The initial phase of the VMP was completed in 2004. In accordance with the environmental permits, most of the work was completed while the ground was frozen; work in remaining areas was completed in the spring and fall.

Massport performed a new obstruction analysis for the airport in 2007 as part of its five year VMP update. The 2007 aerial photogrammetric mapping of all four runways concluded the following:

- The first Five Year VMP had minimized the need for additional vegetation removal in the areas that had removal in 2004;
- Vegetation removal was required in areas that were not part of the first five year VMP; and
- Using the FAA-approved 20:1 approach surfaces for Runway 23, there were obstructions in Bedford's Jordan Conservation Area (JCA), but no obstructions in the Bedford Hartwell Town Forest.

Work associated with the VMP within or adjacent to the three certified vernal pools in Concord was reviewed by the NHESP through the submission of a copy of the NOIs prepared under the Massachusetts WPA for work in or near wetlands. A plan to protect the certified vernal pools during vegetation management operations is incorporated in the VMP.

A 34:1 approach surface analysis was initially prepared for the Runway 23 end, as required by the FAA. In response to Massport and community concerns regarding the extent of vegetation removal needed to maintain a 34:1 surface off-airport in the Bedford Town Forest and the JCA, Massport worked with the FAA and prepared a 20:1 approach surface analysis. Based on this 20:1 approach surface analysis, FAA agreed that required safety margins could be maintained while reducing impact on the JCA and eliminating all impacts on the Hartwell Town Forest.

These conclusions were used to develop the second Five Year VMP (2009-2013), which was submitted to the four towns' Conservation Commission along with NOIs for the required vegetation removal in wetland areas on Massport property. Vegetation removal began in 2009 following the receipt of Orders of Conditions from the town Conservations Commissions. The Orders of Conditions required that wetland work be conducted in frozen or dry ground conditions.

Shortly after the 2009-2013 VMP update received its Order of Conditions, Massport worked with the Town of Bedford to develop an agreement to remove obstructions from the JCA. As part of this agreement, Massport made available trails across its property to make trail connections between Bedford and Concord conservation lands. The planned vegetation removal was completed in 2011, and also included the removal of several obsolete obstruction light poles at the end of Runway 23. By February of 2011, all obstructions identified in the 2007 airspace analysis had been removed. Throughout 2012, Massport continued with maintenance of vegetation removal areas and the trail system, which was opened in September 2011. In 2012, Massport also performed aerial photogrammetric mapping of the airport for the next VMP update.

9.9 Grassland Management Plan

As described above, significant areas of Hanscom Field are mapped as Priority Habitat under the Massachusetts Endangered Species Act. Many of these areas require regular mowing as required by the FAA to meet aviation safety standards. Massport has developed a plan to meet both goals of aviation safety and habitat management.

In 1996, a series of grassland management recommendations were implemented at Hanscom with a limited haying operation. The management strategies were noted to result in an increase in grassland birds, and the program was suspended in 1999 due to an increase in bird strikes (notably barn swallows) at Hanscom Field.

In 2004, Massport developed the Grassland Management Plan. The goal of the Grassland Management Plan is to provide safe operating conditions at Hanscom Field while protecting listed grassland bird species. The plan was finalized with input from the U.S. Department of Agriculture/Wildlife Services (USDA), FAA, and the NHESP. The Grassland Management Plan is included in Appendix F.

The Grassland Management Plan includes the following guidelines for maintenance of portions of the grass infield areas between runways and taxiways at Hanscom Field as well as selected grassed approach areas.

1. Conduct annual pre-breeding season review of grassland management procedures and protected grasslands identification with operations staff.
2. Develop an annual mowing schedule that would maintain managed grassland areas at a height of four to 14 inches.
3. Develop a plan of the managed areas.
4. Mow runway and taxiway areas prior to May 1, when feasible, to avoid conflicts with breeding season.
5. Maintain mowed strips along runways (250 feet from runway centerlines) and taxiways (85 feet from taxiway centerline) throughout the breeding season to discourage birds from nesting in these areas.
6. Restrict mowing during the breeding (nesting and brood-rearing) season (May 1 to July 31) on designated portions of airfield not directly adjacent to runways and taxiways.
7. Conduct pre-mowing field reconnaissance to observe and mark locations of nesting birds in “critical areas” along runways and taxiways.
8. Inspect grassland management areas for young prior to mowing.
9. Avoid, as practical, activities on grassland portions of airfield and approach area not directly adjacent to runways and taxiways during breeding season (May 1 to July 31).

If, after implementation of these recommendations, there is a documented increase in wildlife hazards, bird strikes, or other safety issues, the plan will be modified immediately. NHESP would be notified of any modifications of the plan and the process will involve timely notification of the Conservation Commissions in Bedford, Concord, Lexington, and Lincoln.

9.10 Water Resources

The locations of public water supplies within Bedford, Concord, Lexington, and Lincoln are shown on Figure 9-3. Table 9-5 presents the name, location, type (well or surface water), and community served by each public water supply facility, as well as the approximate distance from the water supply to Hanscom Field. As shown in the table, the municipal water supplies vary in distance from Hanscom Field from 0.9 to 7.3 miles. There have been changes in the public water resources since the 2005 *ESPR*.

Table 9-5 Public Water Supply in Bedford, Concord, Lexington, and Lincoln

Town ¹	Source ID Number	Site Name	Type	Approximate Distance from Hanscom Field ²
Bedford	3023000-11G	Well # 11 (Hartwell Rd. G.P. Well #11)	Groundwater	0.9 miles
	3023000-10G	Well # 10 (Hartwell Rd. Well #10)	Groundwater	0.9 miles
	3023000-12G	Well # 12 (Hartwell Rd. G.P. Well #12)	Groundwater	1.0 miles
	3023000-09G	Well # 5 (Shawsheen G.D. Well #5)	Groundwater	2.2 miles
	3023000-08G	Well # 4 (Shawsheen G.D. Well #4)	Groundwater	2.2 miles
	3023000-02G	Well # 2 (Shawsheen Rd. G.P. Well)	Groundwater	2.3 miles
	3023000-01G	Well # 1 (Page School G.P. Well)	Groundwater	2.3 miles
	3023000-03G	Well # 3 (MITRE/Rte. 62 G.P. Well)	Groundwater	3.5 miles
	3023000-05G	Well # 7 (Turnpike G.P. Well #7)	Groundwater	4.0 miles
	3023000-07G	Well # 9 (Turnpike G.P. Well #9)	Groundwater	4.0 miles
	3023000-06G	Well # 8 (Turnpike G.P. Well #8)	Groundwater	4.2 miles
Concord	3067000-02G	Hugh Cargill G.P. Well	Groundwater	3.1 miles
	3067000-07G	Hugh Cargill Wellfield (Replacement)	Groundwater	3.2 miles
	3067000-06G	Robinson G.P. Well	Groundwater	4.3 miles
	3067000-03G	Deaconess GP Well	Groundwater	4.7 miles
	3067000-01G	Jennie Dugan Well	Groundwater	5.9 miles
	3067000-04G	White Pond Well	Groundwater	6.0 miles
	3067000-08G	White Pond Satellite #1 GP Well	Groundwater	6.0 miles
	3067000-09G	White Pond Satellite #2 GP Well	Groundwater	6.0 miles
	3067000-05G	Second Division GP Well	Groundwater	6.8 miles
	3067015-01G	Valley Sports Inc.	Transient Non-	7.3 miles
Lincoln	3157000-02G	Farrar Pond GP Well	Groundwater	3.1 miles
	3157000-01S	Flints Pond	Surface Water	3.1 miles
	3049000-04S	Hobbs Brook Res. Upper	Surface Water	3.5 miles
	3157000-01G	Tower Rd. GP Well	Groundwater	5.3 miles

Notes:

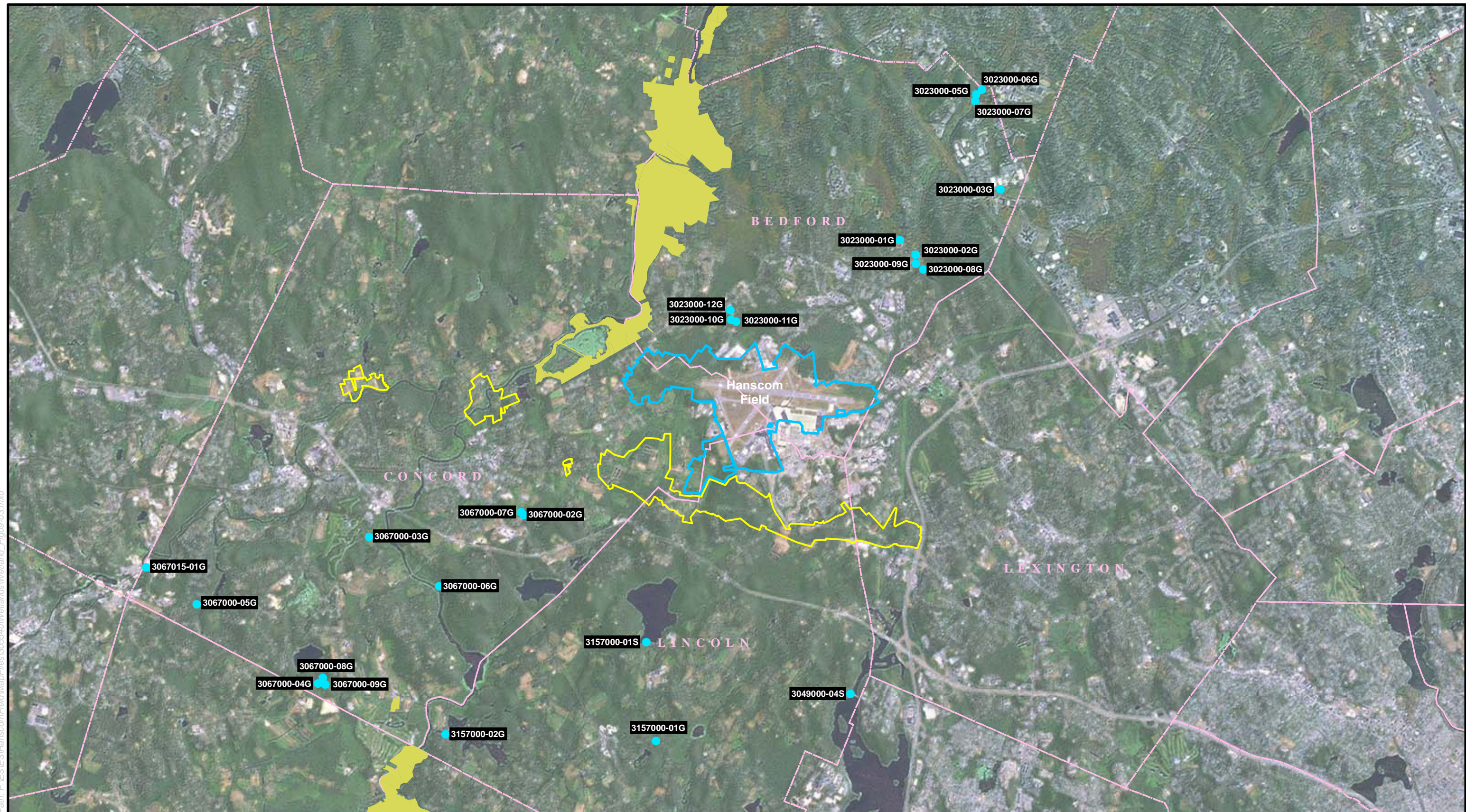
1. Lexington is served by the Massachusetts Water Resource Authority and has no municipal water supply resources
2. Approximate distances measured from Hanscom Field runway intersection

Source: MassGIS, 2012


- Bedford is served in part by the Massachusetts Water Resources Authority (MWRA), and in part by eleven public water supply sources. Since the 2005 *ESPR*, one groundwater well, 3023000-04G, is no longer used.
- Concord is served by ten public water supply sources. Since the 2005 *ESPR*, two of these wells (3067003-01G and 3067016-01G) are no longer used. However, two additional groundwater wells (306700-08G and 3067000-9G), which are co-located next to 30600-04G, have been developed.
- Lexington is served by the MWRA and has no municipal water supply sources.
- Lincoln is served by four public water supply sources.

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- Legend**
- Hanscom Field
 - Minute Man National Historical Park
 - Great Meadows National Wildlife Refuge
 - Town Boundary
 - Public Water Supply Location

 **Hanscom Field 2012 ESPR**
Bedford, Concord, Lexington, Lincoln, Massachusetts

Location of Public Water Supplies in Bedford,
Concord, Lexington, and Lincoln

Data Sources: ESRI (USGS Topographic Maps), March 4, 2013; MassGIS (Community Boundaries), March 5, 2013

Figure 9-3

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Wellhead Protection Areas, which are also known as Zone II areas, are approved under the MassDEP's Drinking Water Program to protect the recharge area around public water supply ground water sources. The Massachusetts Drinking Water Regulations require that public water suppliers delineate Zone IIs and restrict certain land uses and activities in Zone IIs which may result in the contamination of a groundwater drinking supply. Figure 9-4 shows the approved Zone II Wellhead Protection Area that overlaps Hanscom Field. The Zone II area is associated with three Hartwell Road wells in Bedford: Well #10, Well #11, and Well #12. There are no Surface Water Supply Protection Areas (Zone A, B, C) in Hanscom Field.

Rectrix is developing a new above-ground fuel storage facility which will be completed in early 2014 adjacent to the existing Jet Aviation current fuel farm. All fuel storage facilities are subject to the regulatory requirements of 527 CMR 9.00, "Board of Fire Prevention Regulations: Tanks and Containers." Massport's Fire Chief required that the new Rectrix fuel farm meet regulatory standards of the MassDEP at 310 CMR 22.21(2)(b)5, applicable to fuel storage. These measures, as well as elements of Massport's spill prevention program, are designed to protect the recharge area of the Bedford public wells.

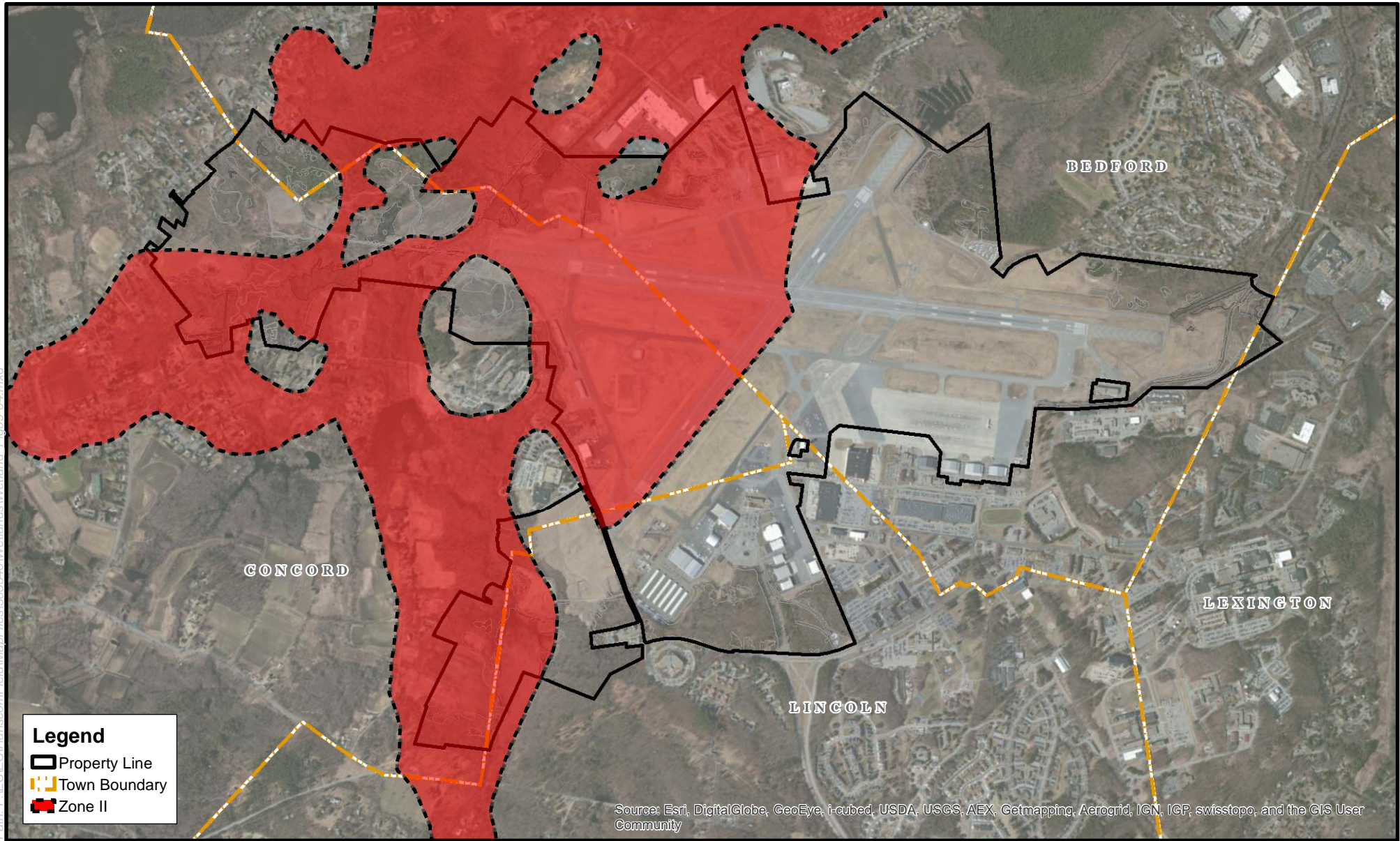
9.11 Regulated Remediation Sites

9.11.1 Hanscom Field

Currently, there are no active MassDEP-listed disposal sites that Massport is responsible for bringing to regulatory closure under the Massachusetts Contingency Plan (MCP). As reported in 2005, there had been only one site, Release Tracking Number (RTN) 3-13953, that was active during the time of the 2005 *ESPR*. As of 2006, this site has been brought to regulatory closure.

For this study, an online search was conducted for sites where a release of oil or hazardous material was reported to the MassDEP. Table 9-6 shows a listing of the MassDEP-listed disposal sites for locations at Hanscom Field for which releases are either still open or were reported since the beginning of 2005. The table indicates which sites are reported as Massport sites and which sites are Massport tenants' sites. There have been several sites at Hanscom Field listed with the MassDEP since the year 2005; however, none of those sites remains open.

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0 1,800 3,600 Feet



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Zone II Wellhead Protection Areas

Table 9-6 2005-2012 MassDEP Reported Releases at Hanscom Field that Reached Response Action Outcome (RAO) Status

RTN ¹	Listed Release Address	Town	Notification Date	Compliance Status	MPA	Tenant
3-13953 ²	200 Hanscom Drive, Civil Air Terminal Maintenance Garage	Bedford	6/28/1996	RAO	X	
3-24535	380 Hanscom Drive-HAFB	Bedford	1/2/2005	RAO		X
3-24594	Hanscom AFB, Building 1201 Heating Plant	Lexington	1/27/2005	RAO		X
3-24856	230 Hanscom Drive, Liberty Mutual Hangar	Lincoln	5/11/2005	RAO		X
3-26380	150 Hanscom Drive, Building #11 West Ramp	Bedford	11/11/2006	RAO		X
3-26954	LG Hanscom Field at 180 Hanscom Dr	Bedford	7/18/2007	RAO		X
3-26720	145 Randolph Road	Lexington	4/2/2007	RAO		
3-27770	180 Hanscom Drive, terminal ramp in front of Building #13	Bedford	6/16/2008	RAO		X
3-27792	Grenier at Barksdale Street	Bedford	6/24/2008	RAO		X
3-27839	Hanscom Drive, North of RW11 Safety Area	Bedford	7/7/2008	RAO		X
3-28281	Eglin and Chenault	Bedford	1/19/2009	RAO		X
3-28933	54 Dow Street, Building 1827	Bedford	12/3/2009	RAO		X
3-29126	104 Barksdale Street Building 1520	Bedford	3/15/2010	RAO		X
3-29203	Eglin Street	Bedford	4/13/2010	RAO		X
3-29456	70 Chennault Street Building 1642	Bedford	8/19/2010	RAO		X
3-30410	180 Hanscom Drive, Signature Flight Support Services Term	Bedford	10/27/2011	RAO		X
3-31035	180 Hanscom Drive	Bedford	8/10/2012	RAO		X
Notes:						
1. Release Tracking Number. Includes those releases reported since the year 2005.						
2. This release is included as it was still active during the time of the 2005 <i>ESPR</i> .						

Source: Massachusetts Department of Environmental Protection

None of the spills since 2005 were at Massport occupied locations. All of the releases occurred on tenant-occupied locations (Table 9-6). Class A-1 or A-2 RAOs have been submitted to the MassDEP documenting that the eleven release conditions have reached regulatory closure with the permanent solution as defined in the MCP.

9.11.2 Hanscom Air Force Base

Hanscom AFB maintained and operated Hanscom's airfield until 1974 and retains responsibility for any required clean-up that stems from this time as well as for any sites on Hanscom AFB property. Hanscom AFB is conducting environmental restoration efforts under the U.S. Air Force Installation Restoration Program (IRP), a federal Comprehensive Environmental Liability Act (CERCLA)-based program. The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) is the primary IRP response process for releases identified under this program. However, because petroleum releases are excluded from the CERCLA program, the MCP is the primary IRP response process at the sites where a release of petroleum has occurred. The U.S. EPA is the lead agency for the NCP sites and the MassDEP is the regulatory agency for the MCP sites.

The objectives of the Hanscom AFB IRP program are generally summarized as the following: protect human health and the environment; characterize risks associated with the release sites; commence

restoration as soon as practicable; initiate removal actions as necessary; develop remedial actions as necessary; conduct long term operation and maintenance of remedial systems implemented for cleanup; and comply with all deadlines, commitments, and regulations applicable to the program.

As part of the IRP, initial field investigations commenced in the summer of 1982. The preliminary assessment/site investigation phase of the IRP resulted in the identification of 22 specific sites as areas with the potential for environmental contamination from past waste management practices. Of the 22 sites, eight are located on Massport property. Investigations and appropriate response actions have been completed at 16 IRP Sites and one IRP Area of Concern, and they have been closed out within the applicable regulatory framework (includes four IRP Sites on Hanscom Field). In addition, investigations have been completed and long-term remedies are in place at the six remaining IRP Sites.

There have been no additional sites added to the IRP list since the 2005 *ESPR*. Figure 9- 5 illustrates the location of the IRP sites/Operable Units (OUs). All of the waste sites identified through the IRP studies have been investigated and, where deemed necessary, have been or are currently being remediated.

Five-Year Reviews of ongoing remedial actions will be conducted as long as any hazardous pollutants or contaminants remain at the site above levels that allow for unlimited and unrestricted exposure as required by CERCLA. The most recent (third) "Five-Year Review for the Hanscom Field/Hanscom AFB Superfund Site" was completed in August 2007. Hanscom AFB Records of Decision (RODs), other Decision Documents, including an MCP Licensed Site Professional (LSP) Opinions/Response Action Outcome (RAO) Statements, and Five-Year Review Reports issued for IRP actions are all subject to concurrence from the U.S. EPA and/or MassDEP. Site Close-Out designation indicates that all required actions are complete and the USAF has received concurrence from the regulatory agencies to that effect, as applicable.

An Interim Record of Decision (IROD) was issued for NPL OU-1 (NPL OU-1 includes IRP Sites 1, 2, and 3) in January 2001 by the USAF, which set forth the requirements for the continued operation of the existing groundwater treatment system, the implementation of institutional controls, and the monitoring of the groundwater and surface water at Hanscom Field/Hanscom AFB. Groundwater beneath OU-1 is contaminated with dissolved-phase chlorinated volatile organic compounds (VOCs) as a result of airfield maintenance and training activities, and the remedy includes a vacuum-enhanced recovery (VER) system and groundwater treatment. Current data indicate that the OU-1 remedial action has been and continues to be effective, and that as of December 31, 2006, the system had treated over 1.6 billion gallons of water.

In August 2002, a ROD was issued selecting the final remedy for NPL OU-3/IRP 21 (former aviation fuel receiving, storage and dispensing site on Hanscom AFB) and, in 2003, the remedial design and construction of the selected remedy was completed. The remedy includes interceptor trenches, a groundwater and petroleum recovery and treatment system with active and passive recovery wells, long-term monitoring, and institutional controls

In November 2000, a ROD was issued for NPL OU3/IRP Site 6 (former filter bed/landfill site on Hanscom AFB) and in 2001, the remedial design and construction of the selected remedy was completed. The remedy included the containment (pervious caps) of three landfill areas, removal of contaminated sediments and landfill debris and placing this material within the capped landfill area, long-term monitoring, institutional controls, and a groundwater compliance boundary.

The assessment of the 2002 five-year review found that the remedy at NPL OU-2/IRP Site 4, a former USAF landfill in the Runway 5 Approach Area that has been capped, continues to be protective of human health and the environment.

9.12 Groundwater Monitoring

Currently, groundwater monitoring is only conducted in association with MCP site cleanup activities. There are no active MCP sites at Hanscom Field and no effects resulting from soil contamination have been observed in the groundwater. Massport's spill prevention program includes development, and implementation of an SPCC Plan, maintenance of contracts with emergency response contractors, and implementation of annual environmental health and safety training that includes spill prevention training.

9.13 Stormwater

Massport encourages new development within areas of existing impervious surfaces that takes advantage of existing infrastructure to enhance groundwater recharge and minimize runoff.

Chapter 2, Facilities and Infrastructure presents information about impervious surfaces at Hanscom Field. The following sections describe the stormwater management program for Hanscom Field, including stormwater modeling, stormwater-related permitting and monitoring programs undertaken by Massport.

9.13.1 Stormwater Modeling

Massport has undertaken a comprehensive stormwater modeling study, which is being coordinated with the MassDEP for the Shawsheen River watershed. The purpose of the modeling effort is to assess current peak and base flows within the river and to evaluate potential Best Management Practices (BMPs) and stormwater controls to reduce the peak flows and increase base flows.

9.13.2 National Pollution Discharge Elimination System Permit

Airports in the United States, including Hanscom Field, are required to apply for coverage under a Stormwater Multi-sector General Permit (MSGP) in accordance with the NPDES permit program, a part of the federal Clean Water Act (33 USC 1251 et seq.). Under this permit program administered by the U.S. EPA, owners and/or operators of airports must satisfy specific requirements for operations conducted at the facility that may affect stormwater quality. Massport applied for coverage under the current MSGP in 2009. Tenants who lease property on Hanscom Field and engage in activities covered under the permit program (see Table 9-7).

Table 9-7 Massport Tenants Covered under the Hanscom Field NPDES Permit

Tenant	Address
Stream Enterprises	140 Hanscom Drive, Bedford
East Coast Aero Club	200 Hanscom Drive, Bedford
Executive Flyers Aviation	200 Hanscom Drive, Bedford
Jet Aviation of America, Inc.	380 Hanscom Drive, Bedford
Liberty Mutual Insurance	230 Hanscom Drive, Bedford
Signature Flight Support	180 Hanscom Drive, Bedford
Nagle Aircraft	145 Hanscom Drive, Bedford
National Aviation Academy	150 Hanscom Drive, Bedford
North Star Aviation	130 Hanscom Drive, Bedford

Source: Hanscom Field NPDES Permit MAR05C14

The current NPDES Permit Tracking Number is MAR05CY14; the permit effective date was February 4, 2009, and it remains valid for five years. Hanscom Field still operates under this multi-sector general permit.

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9.13.3 Stormwater Pollution Prevention Plan (SWPPP)

Massport updated and revised the Hanscom Field SWPPP in June 2013 in compliance with the Stormwater Multi-sector General Permit for Airports program under NPDES. The SWPPP is included in Appendix F. To achieve this goal, the responsibilities of Massport and the tenants include the following:

- Implementing the policies and procedures presented in the SWPPP for the facilities and operations;
- Conducting periodic reviews of policies and procedures to evaluate the effectiveness of the current SWPPP;
- Updating the SWPPP and related information whenever there is a significant physical change at the facility and/or a significant change in the operational procedures of a facility that could result in the discharge of toxic or hazardous pollutants to stormwater or an increased risk of such discharge; and
- Maintaining records of required inspections, operations, materials use, etc. as required in the SWPPP.

The Hanscom Field SWPPP also identifies the following:

- Site drainage areas and stormwater outfall locations (shown on Figure 9-6);
- Activities occurring at the airport and inventory of materials having the potential to affect stormwater quality;
- Recorded significant leaks and spills;
- Observations of dry-weather flow conditions ("non-stormwater discharges") from the storm drainage system;
- Descriptions of potential pollutant sources and risks; and
- Best Management Practices Plan.

Best Management Practices (BMPs) identified in the SWPPP are divided into two sections: Baseline BMPs and Activity-specific BMPs. Baseline BMPs include general procedures to reduce stormwater pollution regardless of the type of operation at Hanscom Field. These BMPs are to be implemented by all tenants covered by the SWPPP. Activity-specific BMPs address particular features or operations at a facility, and are to be applied to a tenant's specific operational situation. The two types of BMPs are identified in Table 9-8.

Table 9-8 Best Management Practices for Stormwater Protection at Hanscom Field

Baseline Best Management Practice	Activity-specific BMPs
• Good Housekeeping	• Emergency Spill Cleanup Plans
• Preventative Maintenance	• Elimination of non-stormwater discharges to storm drains
• Materials Compatibility and Inventory System	• Aircraft, vehicle and equipment maintenance
• Spill prevention and Response Plan	• Aircraft, vehicle and equipment fueling
• Employee Training	• Aircraft, vehicle and equipment washing
	• Aircraft deicing
	• Outdoor handling of material
	• Outdoor material storage
	• Waste handling and disposal
	• Building and grounds maintenance
	• Annual stormwater pollution prevention education

Baseline Best Management Practice	Activity-specific BMPs
	• Lavatory service operations
	• Equipment cleaning/degreasing
	• Runway maintenance
	• Oil/water separators
	• Maintenance of existing drainage systems

Source: Hanscom Field Stormwater Pollution Prevention Plan, January 2009 (last update 5/12).

9.13.4 NPDES Visual Inspection Program

Massport has a visual inspection program, as required under the NPDES Multi-sector General Permit for Hanscom Field, for monitoring the quality of stormwater discharges. The NPDES Multi-sector General Permit for Hanscom Field does not require laboratory water quality monitoring.

The visual inspections are conducted on a quarterly basis (January, April, July, and October).

The inspection procedures consist of collecting samples at stormwater outfall locations at Hanscom Field and visually inspecting the samples for color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other indications of storm water pollution. A visual assessment is performed on samples from the following outfall locations: 1, 2, 4, and 10. Because Outfalls 3, 5, 6, 9, and 10 are from similar drainage areas, only a sample from Outfall 10 is required. A data form is then completed for each observation (see SWPPP for blank data form). If contaminants are observed during the inspections, follow-up investigations are to be performed to determine the probable source of contamination. The results of such investigations are also to be recorded and appropriate actions taken to address the situation.

9.13.5 Stormwater Monitoring Program

Massport conducted a surface water quality monitoring program at stormwater outfalls from Hanscom Field to the Shawsheen River and Elm Brook from 1998 to 2001. Six rounds of surface water samples from three specified locations were collected over the four-year period and submitted for laboratory analysis. The samples were analyzed for the following parameters:

- Temperature
- pH
- Dissolved oxygen
- Five-day biochemical oxygen demand
- Ammonia nitrogen
- Nitrate nitrogen
- Total phosphate
- Priority pollutant 3 metals
- Total petroleum hydrocarbons (TPH)
- Polycyclic aromatic hydrocarbons

Samples were collected during each round from three locations: directly from Elm Brook near the Hanscom Field property boundary; a composite sample from two stormwater outfalls discharging to Elm Brook; and a composite sample from the four Massport outfalls discharging to the Shawsheen River at the Hanscom Field boundary. This monitoring plan was reviewed and approved by the MassDEP. Surface

water sampling was conducted on the following dates: October 7, 1998; February 17, 1999; October 12, 1999; June 28, 2000; April 4, 2001; and August 30, 2001.

The report and the tabular summary of the sampling program are included in Appendix F. Water quality parameters observed in the sampling program are shown in the report along with several benchmark monitoring values. There are no applicable standards that apply to Hanscom Field. The benchmark values are included solely for comparison purposes. The benchmark values are examples of typical concentrations that may be found in inland surface waters and stormwater.

Metal concentrations were below benchmark values for nearly all sample dates and locations. Fecal coliform exceeded thresholds at the Shawsheen River outfalls twice and at the Elm Brook outfalls once, but did not do so at the upstream Elm Brook location on any of the sampling dates. TPH levels were lower at the Hanscom Field stormwater outfalls than in the Elm Brook samples taken from upstream of Hanscom Field stormwater outfalls. Nitrates slightly exceeded benchmarks for some dates at the Shawsheen River and Elm Brook outfalls, and at the upstream Elm Brook location once.

Biochemical and chemical oxygen demand at the upstream Elm Brook location exceeded benchmarks on several sampling dates but rarely did so at the Hanscom Field outfalls. Also, dissolved oxygen was lower than benchmarks at the upstream Elm Brook sampling location for several dates but less frequently at the Hanscom Field outfalls. Overall, samples from the Elm Brook location upstream from Hanscom Field outfalls exceeded benchmarks more frequently, and for more contaminants, than did those from either Hanscom Field's Elm Brook or Shawsheen River outfalls.

9.13.6 Impaired Waters Monitoring

Elm Brook is considered a waterbody requiring a total maximum daily loads (TMDL) in Massachusetts and is listed on the "Massachusetts Year 2008 Integrated List of Waters." Annual monitoring for Total Suspended Solids (TSS) is required from either outfall 8 or 9. In April 2010, a sample was collected from Outfall 9 for impaired waters monitoring per the SWPPP. The sample was analyzed for TSS, and had a result of <5.0 micrograms per liter. Because this result was below natural background levels, further impaired waters monitoring is not required and EPA was notified that sampling was terminated.

9.13.7 Stormwater Mitigation

Massport requires all Hanscom Field site development, including that performed by tenants, to conform to the MassDEP Stormwater Management Guidelines when feasible or applicable. Improved stormwater runoff control has been achieved through the requirement that compensatory storage for stormwater be provided for any projects resulting in increases in impervious surfaces, in order to not increase peak runoff rates.

9.13.8 Spill Prevention Efforts

Massport has maintained a SPCC Plan for Hanscom Field since the 1995 *GEIR*. The SPCC, which was updated in 2012, is a plan outlining the steps to be taken in the event of an accidental petroleum release. Massport tenants are responsible for maintaining their own individual SPCC plans specific to their operations, as needed.

The SPCC plan identifies potential discharge or spill activities that may result in a release, as well as spill prevention measures, control methods and an action plan in the event of a release including notification procedures, key personnel, a listing of available response equipment, tank and fuel delivery checklists,

and contact numbers in case of an emergency. The plan includes a listing of all active oil storage tanks owned and operated by Massport as well as a general listing of other types of smaller volume (55-gallon drum) storage of petroleum-based products including motor oil, waste oil, and hydraulic fluid.

Massport maintains contracts with emergency response cleanup contractors that will respond to Massport or Massport tenant spill events at Hanscom Field. In addition, the Hanscom AFB Fire Department is responsible for responding to emergency situations, including hazardous material spills, at Hanscom Field. The Fire Department maintains detailed spill reports for all reported spills at Hanscom.

The “State of Hanscom” reports indicate that there was one spill at Hanscom Field since 2005. Massport was not responsible for this spill, which occurred in 2008. A tenant reported to Massport and MassDEP that an aircraft had vented fuel, resulting in about one gallon entering the storm drain. As indicated in the 2009 “State of Hanscom,” the storm drain was cleaned, and booms were installed downstream from the storm drain as a safety measure. All MassDEP regulations were followed for cleanup and closure of the incident.

Massport also requires annual environmental health and safety training for its employees at Hanscom Field. The training is designed to review hazardous materials used at the facilities, hazardous waste management, stormwater pollution prevention and SPCC requirements, first responder procedures and general environmental health and safety information. In addition, Massport has developed an Environmental Management Policy and has implemented an Environmental Management System (EMS) at Hanscom Field, which provides the framework for tracking, managing and improving environmental performance. As part of the EMS, spill prevention and emergency preparedness and response procedures were reviewed. A more detailed discussion of the EMS is included in Chapter 11, Sustainable Development and Environmental Management Systems.

9.14 Environmental Audits

Beginning in the late 1980s, Massport has conducted environmental audits for all tenants located at Hanscom Field. The purpose of this program is to ensure that Massport's tenants are operating their businesses in compliance with applicable laws and regulations. Massport works closely with each tenant to ensure that regulatory compliance is achieved and maintained. Any issues raised during the audits are followed up with the tenant until all compliance issues have been resolved.

The tenant audits focus on hazardous waste management, water management, storage tank programs, record keeping practices, training requirements and spill response procedures. Additionally, tenants receive information on BMPs that focus on pollution prevention. Massport tenant facilities have been audited annually since 2001 and biannually for Massport operations at Hanscom Field to ensure compliance as part of Hanscom's EMS.

No significant events relative to tenant noncompliance have been reported since the *2005 ESPR*.

9.15 Deicing Activities

Chemical deicers (i.e., sodium formate) are periodically used on Hanscom runways or taxiways to supplement mechanical equipment such as plows and blowers to enhance safety during inclement winter weather. Sand is applied to increase traction. Sodium formate has shown its effectiveness in snow and ice removal, and has been found to have significantly fewer environmental effects compared with traditional glycol-based deicers.

Aircraft deicing and anti-icing activities at Hanscom Field are currently conducted by Jet Aviation and Signature Flight Support. These entities use products that are a dilute solution of propylene glycol. Most aircraft deicing is conducted near the Civil Air Terminal or the hangars.

Massport employs BMPs both as a part of its sustainability efforts to manage stormwater runoff quality at Hanscom Field, and as a component of its NPDES permit. Aircraft deicing is listed as an Activity-Specific component of Hanscom Field's Best Management Practices. Aircraft deicing is done during snow and ice events by commercial and business aircraft operators, using propylene glycol, which is included in the NPDES permit.

9.15.1 2003 Deicing Study

In April 2003, Massport conducted a computer modeling study of proposed airfield and existing aircraft deicing at Hanscom Field.⁶⁷ The purpose of the study was to summarize existing aircraft deicing practices, evaluate potential airfield deicing alternatives and assess current and potential effects on receiving waters from deicing activities. Neither the EPA nor the MassDEP has identified an "unsafe" concentration of deicing fluid.

The study found that the deicing compounds that were used or were under consideration for use at Hanscom Field at the time of the study exhibited little to no human toxicity and that none was considered harmful by ingestion or has known long-term health effects. The study showed that neither current nor future scenario deicing activities at Hanscom Field would adversely affect the water supply for Bedford, Burlington or any other nearby communities.

9.15.2 Stormwater and In-stream Monitoring Program

After public review and comment on the modeling study, Massport conducted a stormwater and in-stream monitoring program between November 2003 and March 2004 to assess any actual impacts from deicing activities and to confirm the results of the modeling study. No additional sampling has occurred since then. The sampling program consisted of seven sampling events for nine parameters. One event determined background concentrations while five events targeted stormwater and in-stream water quality during storm events when sodium formate and propylene glycol were being applied at the airport. One event quantified sodium concentrations in stormwater discharged to the Shawsheen River from road salt (sodium chloride) applications.

During each event, several rounds of samples were collected from up to ten locations (three in-stream locations, five outfall locations, one manhole location, and one culvert location). Samples were analyzed for propylene glycol concentration, sodium concentration, dissolved oxygen, chemical oxygen demand, carbonaceous biological oxygen demand, salinity, conductivity, temperature, and pH. Sodium measurements were used to calculate the sodium formate concentration in the aqueous samples. Dissolved oxygen, chemical oxygen demand and carbonaceous biological oxygen demand were used to determine the potential environmental effects of the use of the deicers. Salinity, conductivity, temperature and pH were used to monitor changes in the general characteristics of the stormwater and surface water bodies. Data from the monitoring program are presented in Appendix F.

The data collected during the monitoring program indicate that the concentrations of sodium formate and propylene glycol in the Shawsheen River and Elm Brook do not exceed aquatic toxicity levels. The data

⁶⁷ Massachusetts Port Authority, "Hanscom Field Deicing Study," CDM, April 15, 2003

also demonstrate that water quality parameters, such as dissolved oxygen, are not affected by the discharge of the sodium formate and propylene glycol to the surrounding aqueous environments. The sodium concentrations measured in stormwater flow from the airfield ranged between 2.2 milligrams per liter and 92 milligrams per liter. When the highest sodium concentration of 92 milligrams per liter is converted to a sodium formate equivalent, the corresponding sodium formate concentration is 272 milligrams per liter, which is well below the established aquatic toxicity level of 1,000 milligrams per liter.

Propylene glycol was found to be discharged primarily at one outfall located at the headwaters of the Shawsheen River. The in-stream propylene glycol concentrations found in the Shawsheen River ranged between not detected (with a detection limit of 2 milligrams per liter) and 270 milligrams per liter. The highest in-stream propylene glycol concentration found in the Shawsheen River, 270 milligrams per liter, is well below the reported aquatic toxicity level of 3,200 milligrams per liter. Propylene glycol was not detected in the Elm Brook.

Decreases in dissolved oxygen in the Shawsheen River due to propylene glycol discharge were not observed. The lowest dissolved oxygen measurement at the in-stream location of the Shawsheen River on Hanscom AFB during the study was 7.1 milligrams per liter, which is comparable to the background concentration of 7.3 milligrams per liter and above the state minimum standard of 5.0 milligrams per liter. Levels of chemical oxygen demand and carbonaceous biological oxygen demand above background concentrations at this location were observed to be directly correlated to propylene glycol discharge. The dissolved oxygen data suggests that this aquatic system is able to buffer the oxygen demand imposed by discharges of propylene glycol.

Based on the data collected during the Hanscom Field deicing study, it was determined that the concentrations of both sodium formate and propylene glycol in the Shawsheen River and Elm Brook do not exceed established levels for aquatic toxicity and do not adversely affect other aquatic parameters (e.g. dissolved oxygen). Therefore, the use of these deicing/ anti-icing agents does not result in adverse effects on the receiving waters.

9.16 Analysis of Future Scenarios

The 2012 *ESPR* future scenarios are used to evaluate the potential cumulative environmental effects that could occur if Hanscom Field reaches the airport activity levels that are described in Chapter 3, Airport Activity Levels. The 2020 and 2030 scenarios are estimates of what could occur (not what will occur) in the future using certain planning assumptions and are not necessarily recommended outcomes. The 2020 and 2030 master planning scenarios are presented in Chapter 4, Airport Planning. Massport encourages that new development be focused within areas with existing impervious surfaces that take advantage of available infrastructure and minimize impacts on habitat and water quality.

The 2020 and 2030 scenarios would not be expected to result in impacts on vernal pools, rare or endangered species, or water quality. Each of the planning concepts assumed to occur over these time periods would be situated more than one-half mile from any of the certified vernal pools at Hanscom which are located in the western portion of the airport. None of the facilities described in these scenarios would occupy nesting areas of the rare species of grassland birds in the infields of the airport runways or aquatic areas and adjacent uplands utilized by Blanding's and Wood Turtles. Indirect impacts from projects in the vicinity of these nesting areas would not be expected to disrupt these populations since these species currently occupy an active airport environment. Potential water quality impacts would be

avoided through the continued implementation of the SWPPP and conformance with applicable standards for stormwater management required for site development or redevelopment by the MassDEP.

Some of the planning areas in the 2020 and 2030 scenarios contain wetland resources or are located near wetlands. Massport would make every effort to avoid, minimize, and mitigate potential wetland impacts for future Massport or tenant projects. Projects involving work within wetland resource areas or their buffer zones would require applications to the appropriate conservation commissions for permitting under jurisdiction of the WPA. Potential effects of the planning scenarios on wetlands, wildlife and water resources are described below.

9.16.1 Wetlands

The assessment of potential wetland impacts is a worst-case analysis assuming all the facilities described in the Planning Year Scenarios were constructed for each study year. Table 9-9 shows the facilities and the potential wetlands affected.

Table 9-9 Potential Work near Wetlands in 2020 and 2030 Scenarios

Location	Planning Concepts	Location of Potential Wetland Impacts	
		2020 Scenarios	2030 Scenarios
Terminal Area	GA facilities with new parking spaces Salt storage/maintenance facility Jet Aviation to replace Hangar 17 with associated ramp and parking Civil Air Terminal enhancements Air & Space Museum Hotel Parking	Wetlands 3-1 Wetlands 3-2 Wetland 1 Wetland 4	Wetland 3-1 Wetland 3-2 Wetland 3-3 Wetland 3-5 Wetland 1 Wetland 2 Wetland 3 Wetland 4
ATCT Apron	Relocation option for customs facility Expansion of the airport maintenance facility Alternative landside access GA hangar development	None	None
East Ramp Area	GA/corporate hangars Cargo hangar/facility T-hangars Access Road from Hartwell Avenue Relocation option for customs facility	Riverfront Area adjacent to Shawsheen River Wetland 1-1 buffer zone	Riverfront Area adjacent to Shawsheen River Wetland 1-1 buffer zone
North Airfield Area	GA/corporate hangars (Hartwell Road site)	Wetland 2-9	Wetland 2-9 Wetlands 1-3

Projects undertaken at Hanscom Field that involve work within wetland resource areas (including Riverfront Area) or buffer zones would require review and approval by the applicable conservation commission(s) through the submission of appropriate applications (NOI, Requests for Determination of Applicability, etc.) under the WPA. Approval of work within a resource area generally requires conformance with WPA performance standards identified in 310 CMR 10.54 through 10.58 for each resource area category, and an Order of Conditions issued by the conservation commission(s). Impacts to wetlands regulated under the Federal Clean Water Act, but not by the WPA, or impacts exceeding the area thresholds established in the WPA performance standards, could also require a Section 404 Individual Permit from the USACE, and/or Water Quality Certification from the MassDEP under Section 401 of the Federal Clean Water Act. Massport would work to refine plans to avoid or minimize potential wetlands impacts.

9.16.1.1 2020 Scenario

Work may occur near wetlands in three of the four planning areas in the 2020 scenario. In the Terminal Area, plans to expand hangars and work on the first phase of the Air and Space Museum could affect wetlands in the south part of the area. While all work considered for the East Ramp would be on impervious area, the access road from Hartwell Avenue could occur in the Riverfront Area. In the North Airfield, work could be located in the buffer zone of drainage wetlands located in the infield.

9.16.1.2 2030 Scenario

For the 2030 scenario, conditions are the same as described above for both the East Ramp and the North Airfield. As for the Terminal, additional work in the undeveloped area west of the Terminal access road could result in wetlands and buffer zone impacts.

9.16.2 Vernal Pools

Any future projects proposed within or adjacent to the certified vernal pools would need to be reviewed by the NHESP through the submission of a copy of a NOI prepared under the WPA. None of the proposed projects contemplated in either the 2020 or 2030 scenarios is located near the three vernal pools and therefore no impacts will occur.

The certified vernal pools are located near the end of Runway 11 where vegetation management operations may occur. As with the current VMP, which details vegetation management at Hanscom Field, future vegetation removal projects developed for the period from 2012 through 2020 will be based on the VMP and will incorporate plans to protect vernal pools. These future projects, which are within the guidelines established in the VMP, would also undergo review by the appropriate conservation commissions and the NHESP. A plan to protect the certified vernal pools during vegetation management operations has been incorporated in the Hanscom Field VMP, which was approved by the four conservation commissions.

9.16.2.1 2020 Scenario

No impacts to three certified vernal pools near the western end of Runway 11-29, or their wildlife habitat value, would result from the potential locations for new facilities in the 2020 scenario. The potential location of a facility nearest to the vernal pools would be GA hangar development in the North Airfield Area, situated approximately 3,400 feet to the east.

9.16.2.2 2030 Scenario

No impacts on wetlands will occur from development in the 2030 scenario. Development areas are the same as the 2020 scenario (just augmented) and therefore risk of impact is the also the same.

9.16.3 Rare and Endangered Species

No potential action considered under the 2020 or 2030 scenarios would impact habitat of rare and endangered species.

As noted in the Rare and Endangered Species section above, two rare species of grassland birds have been observed at Hanscom Field: upland sandpiper (endangered) and grasshopper sparrow (threatened). Each of these species nests within runway infield areas that are periodically mowed to maintain grassland vegetation for safe aircraft operation. In addition, two turtle species have also been identified. These amphibians inhabit aquatic areas and the adjacent uplands. Any project proposed in the buffer zone of a

wetland or in the Riverfront Area associated with a perennial stream must file a NOI with the conservation commission. Should any work be proposed in areas previously utilized by Blanding's or Wood Turtles, the project will also be reviewed by the NHESP. No development is contemplated near the brooks and streams where they occur.

9.16.3.1 2020 Scenario

Proposed development considered in the 2020 scenario is not proposed in areas mapped as Priority Habitat for Rare Species. Grassland bird species are located in the grassy airfields areas which are not included in the 2020 planning scenarios. One site, the GA/Corporate hangar development in the North Airfield Area, would be situated across a taxiway from an infield where grasshopper sparrows have been observed in the past. Since the nesting activity has occurred under the existing and higher historic activity levels at the airport, the GA hangar development in this location would be expected to have no effect on the continued usage of the infield as a nesting site. Similarly, the anticipated increases in aircraft landings and takeoffs through 2020 would not be expected to affect usage of the runway infields as nesting sites by these rare bird species.

Turtle species are located in brooks and streams and occur in adjacent uplands. These species are primarily associated with Elm Brook and the Shawsheen River on Hanscom which occur on the western and northern part of the airport and flow north. No work in the 2020 scenario is proposed across or adjacent to either of these waterways. The closest area is again the North Airfield which is approximately 1,000 feet from Elm Brook at its closest point.

9.16.3.2 2030 Scenario

No impacts to rare and endangered species will occur from development in the 2030 scenario. Development areas are the same as the 2020 scenario (just augmented) and therefore risk of impact is the also the same.

9.16.4 Water Quality

Since all components under the 2020 or 2030 scenarios would be required to meet requirements of the NPDES Permit and applicable MassDEP standards for stormwater management, the potential for water quality impacts under the planning year scenarios are expected to be similar to each other. In addition, most of the development contemplated in the Master Planning areas will occur in areas of existing impervious development and will minimize water quality and quantity impacts.

9.16.4.1 2020 Scenario

Massport will continue to follow, and will require tenants at Hanscom Field to follow, the development and facility operational requirements under the then-current NPDES Permit. All potential new facilities in the 2020 scenarios would also continue to be required to meet applicable MassDEP standards for stormwater management, when feasible. Therefore, the 2020 scenario is not anticipated to result in any impacts to water quality, and the continued Best Management Practice efforts would be expected to result in improvements to water quality over time. Ongoing groundwater remediation efforts noted in the Groundwater Conditions and Water Quality portion of this chapter would also be expected to improve water quality on and off site. In addition, the majority of any new development would be located in existing impervious areas. Areas where impervious surfaces could increase include the Terminal (2.1 acres) and the North Airfield (7.0 acres). Massport will review areas where existing pavement can be removed to achieve no net increase in impervious surface if these projects are to move forward.

The potential GA/corporate hangar sites in the North Airfield are located in the Zone II Wellhead Protection Area for the Bedford wells. Massport would work with potential developers of the GA/corporate hangar sites in the North Airfield to ensure that any potential facilities are designed to protect the recharge area of the Bedford public wells. These measures, as well as elements of Massport's spill prevention program, are designed to protect the recharge area of the Bedford public wells.

9.16.4.2 2030 Scenario

Conditions for the 2030 scenario will be similar to those described for 2020. Impervious surface will potentially increase should additional areas contemplated for development become developed. The incremental increase in impervious surface from the 2020 scenario would be 5.1 acres in the Terminal and 2.4 acres in the North Airfield. Massport will review areas where existing pavement can be removed to achieve no net increase in impervious surface if these projects are to move forward.

10 Cultural and Historical Resources

This chapter provides information about existing cultural and historical resources, as well as recreational, conservation, and agricultural resources, at Hanscom Field and in areas adjacent to Hanscom Field.

The documentation of historical and archaeological resources in Bedford, Concord, Lexington, and Lincoln includes resources currently listed in the State and National Registers of Historic Places (State and National Registers), the Inventory of the Historic and Archaeological Assets of the Commonwealth (Inventory), and the Massachusetts Cultural Resource Information System (MACRIS) that are maintained by the Massachusetts Historical Commission (MHC). This review was based on the detailed analysis in the *2005 ESPR*, updated with current information and supplemented through discussions with the historic commissions for each of the four towns and the incorporation of any information they provided.

The inventory update of existing cultural and historical resources included a review of the status of historic buildings and landscapes in Minute Man National Historical Park (MMNHP). The National Park Service (NPS) also provided updates on the status of its activities including soundscape goals, management plans, and interagency workgroup that was formed to review impacts on the MMNHP.

Conservation and recreational resources were identified through a review of available MassGIS data, research of town plans, and follow-up discussions with Town Planners in Bedford, Concord, Lexington, and Lincoln.

This updated information is used as a basis for the evaluation of the cumulative environmental effects of Hanscom Field in 2012. The *2012 ESPR* describes the potential cumulative environmental effects that could occur if Hanscom Field reaches the airport activity levels that are described in Chapter 3, Airport Activity Levels. The 2020 and 2030 scenarios represent estimates of what could occur (not what will occur) in the future using certain planning assumptions and are not necessarily recommended outcomes. The future commercial service scenarios are consistent with Massport's 1980 Regulations for Hanscom Field, which prohibit scheduled commercial passenger services with aircraft having more than 60 seats.

The EEA Scope Certificate of May 18, 2012 for the *2012 ESPR*, directed Massport review the existing data on historic and archaeological resources at Hanscom Field, including the most current version of the State Register, the files of the MHC, and consultation with the towns. In addition, the Certificate stated that the *2012 ESPR* should describe Massport's efforts to address concerns raised by NPS and the U.S. Fish and Wildlife Service (USFWS). It should address NPS concerns about the potential impacts of noise on the waterfowl, shore birds, marsh birds, and turtles that use the Concord River basin. The *ESPR* should report on the status and any published recommendations of the Federal Interagency Working Group that was formed to review impacts on the MMNHP and on the NPS's soundscape goals and plans for the Park. The *ESPR* should also identify how it will work with the four communities and the Massachusetts Department of Agricultural Resources (MDAR) to protect Massport-owned agricultural land from conversion to non-agricultural uses.

10.1 Key Findings Since 2005

Based in input from the four host towns and independent research of state files and in the field, there have been a few additions to the cultural and historic resources inventory for the area. The analysis of potential impacts on cultural and historical resources demonstrates that impacts have decreased since 2005 as a result of a decline in aircraft operations, advances in aircraft technology, and operational measures that have been implemented including the Fly Friendly Program in 2009.

Based upon the recent update of the status of historic resources within and around Hanscom Field, there are currently a total of 61 historic properties (i.e., 39 individual resources and 22 districts (with the MMNHP counted as one district)), that are included in or determined eligible for the National and State Registers in the 6,000-acre general study area for the *2012 ESPR*⁶⁸. The resources range from individual houses to large historic districts with structures and associated landscape settings, including 12 National Historic Landmarks. The NPS has identified 106 resources that contribute to the historic significance of the MMNHP.

The *2012 ESPR* also updates the *2005 ESPR* reconnaissance survey of resources that are 50 years or older and the noise analysis for historic properties within the area with the maximum forecasted noise values for each of the ESPRs. In 2005, the reconnaissance survey area was defined as the area inside the 2020 high growth 55 dB DNL noise contour line, and in 2012 it is the area within the 2030 planning year 55 dB DNL noise contour line. The 2005 reconnaissance survey and the 2012 update also encompassed the areas within a 200-foot radius of the 16 Traffic Study Areas located at various road intersections outside of the Hanscom Field boundary. Since the projected 2030 noise contour in the *2012 ESPR* covers a smaller area than the forecasted 2020 high growth noise contour in the *2005 ESPR*, the numbers of historic properties are significantly reduced. Within the defined area, the reconnaissance survey encompassed properties listed or eligible for inclusion in the National and State Registers, and resources included in the MHC's Inventory and MACRIS. It also provided a preliminary identification of resources that are 50 years old or older which have not been previously surveyed. The analyses included properties on Hanscom Field and Hanscom AFB.

The 2012 survey update for the area inside the 2030 55 dB DNL noise contour line identified three individual historic properties (Deacon John Wheeler/Capt. Jonas Minot Farmhouse (aka Thoreau Birthplace), 341 Virginia Road in Concord; Wheeler-Meriam House, 477 Virginia Road in Concord; and Simonds Tavern, 331 Bedford Street in Lexington) and a small section of MMNHP that are listed in or eligible for inclusion in the National and State Registers (versus 32 individual properties and 20 districts in 2005). All four towns have extensive entries of historical resources in the MHC Inventory and MACRIS. The 2012 update of the *2005 ESPR* reconnaissance survey found that there are currently 54 individual historic properties and 7 districts that are included in the MHC Inventory and MACRIS (versus 359 individual properties and 51 areas in 2005). The reconnaissance survey of properties that are 50 years or older completed for the *2005 ESPR* had identified an additional 336 individual properties and 11 locations within that survey area that had not been previously documented. The 2012 reconnaissance survey update confirmed the findings of the earlier reconnaissance survey for the new defined area; consisting of approximately five individual properties and portions of three survey areas.⁶⁹

⁶⁸The general study area consists of the portions of the towns of Bedford, Concord, Lexington, and Lincoln that are shown as a rectangular area in the map figures in this chapter

⁶⁹Adams et al. (PAL), *Historic Resources Reconnaissance Survey Information in Support of 2005 Hanscom Field Environmental Status and Planning Report, Bedford, Concord, Lincoln, and Lexington, Massachusetts*, 2006.

The survey update for the 2012 *ESPR* included a review of State Register, MHC site files Inventory, and MACRIS to amend the identification of recorded archeological sites within Hanscom Field or near the sixteen traffic study intersections that are described in Chapter 6, Ground Transportation. The review completed for the 2005 *ESPR* identified one recorded site outside Massport property that is near the intersection of Hanscom Drive and Old Bedford Road. An additional 39 sites that have not been evaluated for eligibility on the State and National Register were identified in Bedford, Concord, Lexington and Lincoln. This included six sites completely or partially within the property line of Hanscom Field. A 2005 archaeological overview and assessment of MMNHP reported that there were more than 100 prehistoric and historic period archaeological sites identified within the Park.⁷⁰

The reconnaissance archaeological survey conducted for the 2005 *ESPR* found that most of Hanscom Field, however, has been previously disturbed by construction. The reconnaissance survey was conducted within the 2005 55 dBA DNL noise contour line that included Hanscom Field, Hanscom AFB, and sections of Bedford, Concord, Lexington, and Lincoln. Areas of high pre-contact archaeological sensitivity in the project area include previously undisturbed, dry, level areas located adjacent to the natural brooks and wetlands in the peripheral portions of the Hanscom Field. The extreme southern section of Hanscom Field and the intersections along Route 2A have moderate to high archaeological sensitivity for post-contact resources associated with the April 19, 1775 engagement along Battle Road, now part of the MMNHP. The update for the 2012 *ESPR* determined that existing conditions within the Hanscom area have remained largely unchanged since the 2005 *ESPR* and that no new archaeological sites have been identified within project study area.

The 2012 *ESPR* describes the environmental effect of traffic and air quality on cultural and historic resources. The findings show that the environmental effects of traffic and air quality on cultural and historic resources have decreased since 2005. In 2012, Hanscom Field represented approximately four percent of peak hour traffic on Route 2A. In 2012, Hanscom Field traffic exceeded the ten percent MEPA threshold at one intersection on Route 2A in the MMNHP: #6) Hanscom Drive/Route 2A in Lincoln. As described in Chapter 8, Air Quality, there were no adverse effects attributable to air quality in 2012.

Chapter 7, Noise reports noise levels at Hanscom Field in terms of DNL contours for 55, 60, 65 and 70 dBA exposure. Table 10-1 summarizes noise exposure on National and State Register properties, the MMNHP, and key conservation and recreational facilities by identifying those resources within the 65 dBA DNL and 55 dBA DNL contours. Of these resources, approximately 0.1 acres of the Hartwell Town Forest/Jordan Conservation Area fell within the 65 dBA DNL contour in 2012 as compared to 1.4 in 2005. Locations within the 55 dBA DNL contour align with runway ends and air traffic patterns to the south and west [e.g., portions of the Concord River and the Great Meadows National Wildlife Refuge (GMNWR)] or within close proximity to Hanscom Field (e.g., historic sites on Virginia Road). Massport and the NPS have been cooperating on the implementation of the Fly Friendly program instituted in 2009 with a noise abatement program and voluntary measures to minimize noise impacts on the MMNHP and residential areas.

The DNL noise exposure levels at National and State Registers historic properties in the 2020 and 2030 scenarios decrease from 1.5 to 2.0 decibels below 2005 *ESPR* levels in the 2020 scenario to 0.5 to 1.0

⁷⁰Herbster (PAL), *Archeological Overview and Assessment, Minute Man National Historical Park, Concord, Lincoln, and Lexington, Massachusetts*, 2005. Banister and Herbster (PAL), *Archaeological Reconnaissance Survey, Hanscom Field: 2005 Environmental Status & Planning Report, Bedford, Concord, Lexington, and Lincoln, Massachusetts*, 2006.

decibels below 2005 levels in the 2030 scenario. When compared to 2012 noise levels (which decreased from 2005), noise levels increase by 0.5 dB in 2020 and by 1.5 dB in 2030. As Table 10-1 indicates, only the Hartwell Town Forest/Jordan Conservation Area fell within the 65 dBA DNL contour, with the area impacted ranging from 0.1 acres in the 2020 scenario to 0.9 acres in the 2030 scenario. That increases to 66.4 and 72.1 acres of land in the 2020 and 2030 scenarios respectively for area exposed to the 55 dBA DNL contour. The GMNWR, which had the highest acreage within the 55 dBA DNL contour in 2005, dropped below Hartwell Town Forest/Jordan Conservation Area in 2012 and the forecast years.

In the 2020 and 2030 scenarios, Hanscom Field represents four and seven percent respectively of peak hour traffic on Route 2A. Hanscom Field traffic exceeds ten percent of a single traffic movement at one Route 2A intersection in the 2020 scenarios and four Route 2A intersections in the 2030 scenarios. As described in Chapter 8, Air Quality, there are no adverse effects attributable to air quality in 2012 or the 2020 and 2030 scenarios.

Massport supports Transportation Demand Management (TDM) strategies to reduce its contribution to traffic on area roadways, as well as potential traffic management strategies that do not require physical modification to intersections. No physical modifications are proposed to intersections and, therefore, there are no adverse effects to the identified historic and archeological resources in 2012 or the 2020 and 2030 scenarios. Some of the potential airport facilities in the 2020 and 2030 scenarios would be located within areas assessed as having a high archaeological sensitivity. Additional archaeological investigation within these areas would be recommended if these concepts moved forward to planning and design and if below ground impacts were proposed. The 2006 reconnaissance survey, as updated in 2013, will guide such efforts.

Massport will continue to work with the MDAR to determine appropriate measures to protect Massport-owned agricultural lands from conversion to non-agricultural uses. Massport will inform the towns about actions related to agricultural lands as part of its briefings at HFAC meetings.

10.2 Year 2012 Conditions

This section presents conditions in 2012 for cultural and historical resources within Hanscom Field and in the reconnaissance survey area that is illustrated in Figure 10-1. The noise analysis location labels in this figure are tied to information that is presented in Tables 10-2 through 10-5 and Table 10-13 for the MMNHP. The description of 2012 resources focuses first on historical resources, then archaeological resources, and concludes with MMNHP. This discussion is followed by a survey of recreation and conservation lands in each of the four towns, as well as the GMNWR. The chapter concludes with a review of agricultural resources. Noise and traffic are then assessed. The analysis presented in Chapter 8, Air Quality indicates that there are no adverse effects attributable to air quality in 2012.

The noise analysis evaluates the 65 dB DNL noise contour and the 55 dB DNL noise contour. The 65 dB DNL noise contour was used as a guideline for determining potential land use incompatibilities, in accordance with FAA guidelines. The EEA Scope for the 2012 *ESPR* identified the 55 dB DNL noise contour for inclusion in the noise analysis.

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Historic and archaeological resources are identified for areas within 200 feet of the sixteen traffic study intersections to provide baseline data to assess potential traffic effects on these resources. Traffic concerns are related to overall traffic volumes on roadways, particularly Route 2A through the MMNHP, and the operation of intersections with consideration of intersection modifications to improve capacity. Although Hanscom Field traffic made up only four percent of the traffic on Route 2A during the morning peak hour and afternoon peak hour in 2012, Massport is committed to Transportation Demand Management and traffic management approaches that do not involve physical changes to intersections, if potential improvements are warranted to address identified needs. Appendix G summarizes historic resources near the sixteen intersections.

Table 10-1 Summary of Noise Effects on Cultural and Historic Resources

Resource ¹	Total Quantity ²	Total Properties or Geographic Area within the 65 DNL Contour ³			
		2005	2012	2020	2030
National and State Registers Individual Properties ⁴	39 properties	0 properties	0 properties	0 properties	0 properties
National and State Register Historic Districts ⁵	1646. acres	0 acres	0 acres	0 acres	0 acres
Minute Man National Historical Park	975.4 acres	0 acres	0 acres	0 acres	0 acres
Battle Road Interpretive Trail	4.0 miles	0 miles	0 miles	0 miles	0 miles
Minuteman Commuter Bikeway	10.1 miles	0 miles	0 miles	0 miles	0 miles
Narrow Gauge Rail-Trail	3.0 miles	0 miles	0 miles	0 miles	0 miles
Hartwell Town Forest/ Jordan Conservation Area	165.9 acres	1.4 acres	0.1 acres	0.1 acres	0.9 acres
Great Meadows National Wildlife Refuge	3409.0 acres	0 acres	0 acres	0 acres	0 acres
Concord River ⁶	6.5 miles	0 miles	0 miles	0 miles	0 miles
Resource ¹	Total Quantity ²	Total Properties or Geographic Area within the 55 DNL Contour			
		2005	2012	2020	2030
National and State Register Individual Properties ⁴	39 properties	3 properties	3 properties	3 properties	3 properties
National and State Register Historic Districts ⁵	1646.2 acres	2.4 acres	0 acres	0 acres	0 acres
Minute Man National Historical Park	975.4 acres	1.7 acres	0 acres	0 acres	0.4 acres
Battle Road Interpretive Trail	4.0 miles	0 miles	0 miles	0 miles	0 miles
Minuteman Commuter Bikeway	10.1 miles	1.3 miles	0.3 miles	0.4 miles	0.5 miles
Narrow Gauge Rail-Trail	3.0 miles	1.3 miles	0 miles	0 miles	0 miles
Hartwell Town Forest/ Jordan Conservation Area	165.9 acres	118 acres	26.4 acres	66.4 acres	72.1 acres
Great Meadows National Wildlife Refuge	3409.0 acres	210 acres	26.4 acres	43.1 acres	94.4 acres
Concord River ⁶	6.5 miles	0.5 miles	0 miles	0 miles	0.1 miles
Notes:					
1. See Tables 10-19 and 10-20 for more detail on National and State Registers individual properties and historic districts.					
2. All surveyed historic properties; total acreage of surveyed historic districts, Minute Man National Historical Park, Hartwell Town Forest/Jordan Conservation Area, and Great Meadows National Wildlife Refuge; and, total length of trails and Concord River.					
3. This is the exposure level that the FAA identifies as a guideline for determining potential land use incompatibilities.					
4. Does not include Minute Man National Historical Park sites. In this table, the noise effects are quantified through the estimation of park acreage within a given contour.					
5. Includes Bedford Depot Park Historic Dist., Bedford Historic Dist., and Old Bedford Center Historic Dist. in Bedford; American Mile Historic Dist., Barrett Farm Historic Dist., Concord Monument Square-Lexington Road Historic Dist.,					

Hubbard-French Historic Dist., Hubbardville Historic Dist., Main Street Historic Dist., and North Bridge-Monument Square Historic Dist. in Concord; Battle Green Historic Dist., East Village Historic Dist., Hancock-Clarke Historic Dist., Lexington Green Historic Dist. and Munroe Tavern Historic Dist. in Lexington; and, Lincoln Historic Dist. in Lincoln. Areas of overlap in districts are counted once.

6. Concord River is approximately 6.5 miles in length from State Route 2 (South of Airport) to State Route 225 (North of Airport)

10.3 Designation Process

Information on historic and archaeological resources in the *2012 ESPR* is based on updating data that was collected in a series of planning steps for the *2005 ESPR*. This consisted of reviewing the 2005 survey results, updating baseline research, and conducting a drive over/walkover field survey to verify the current conditions. This results in an updated reconnaissance-level preliminary list of known resources and sensitive areas. In the future, an intensive-level survey may be conducted that examines the history, context, and physical characteristics of all or selected historic resources in more detail, culminating in MHC Inventory forms, entry in MACRIS, and evaluation of eligibility for listing in the National and State Registers of Historic Places.

Individual properties and historic districts eligible for listing in the National Register of Historic Places must meet criteria established by the NPS, possess historic integrity, and be significant in local, state, or national history. Properties are nominated through the MHC. The National Register is the nation's official list of historic properties deemed worthy of protection and is overseen by the NPS. The State Register of Historic Places, maintained by the MHC, is an umbrella compilation of historic properties and districts that have been designated as historically significant in one or more different programs at the local, state, and national level. The State Register consists of inventoried historical resources that have been evaluated and formally designated as historically significant due to meeting the criteria for listing in one of the following categories: National Historic Landmark designated by the U.S. Congress; listed or formally determined eligible for inclusion in the National Register of Historic Places; Massachusetts Archaeological or Historic Landmark designated by MHC; Local Landmark or Local Historic District determined by a community; Regional Historic District established by State legislature; or subject to a Preservation Restriction managed by the MHC. MHC updates the State Register regularly, and the January 2013 edition was consulted for current information included in the *2012 ESPR*. Information from the National and State Registers is presented in the section below.

10.4 Historical Resources

This section updates the status of historical resources within Hanscom Field, Hanscom AFB, and an area of approximately 45 square-miles that is depicted in Figure 10-1 and defined as the general study area. Data collection methodologies included review of documents, reports, agency files and databases, archival materials, and historic maps. Interviews and information sharing meetings were conducted with National Park Service representatives from the MMNHP, and the local historical commissions of Bedford, Concord, Lexington, and Lincoln.

Available planning studies conducted within or adjacent to Hanscom Field were also consulted. The results informed the list of noise analysis locations that were the basis of the Chapter 7 noise analysis. Information was also integrated into the reconnaissance historic and archaeological resources survey updates completed in 2013 for the *2012 ESPR*.

10.4.1 National and State Register Resources

The existing conditions for National and State Registers-listed historic resources were assessed for the area shown in Figure 10-1. Both the 1988 and 1995 *GEIRs* identified 32 (national, state, and local) historic architectural building resources and districts in the general study area. The 2000 *ESPR* identified a total of 43 historic buildings and/or districts included in the State Register. The 2005 *ESPR* identified a total of 52 historic resources, or 32 historic buildings and 20 districts (with the MMNHP counted as one district), included in the State Register within the general study area for the 2005 *ESPR*. An updated review was completed of the National and State Registers, the MHC Inventory, and MACRIS that are all maintained by the MHC for inclusion in the 2012 *ESPR*.

Based upon the recent investigations, a total of 61 historic resources, or 39 individual historic properties and 22 districts (with the MMNHP counted as one district), are currently included in, or determined eligible for inclusion in, the National and State Registers within the general study area for the 2012 *ESPR*. These resources are listed in Tables 10-2 through 10-5 and shown in Figure 10-1.

The resources range from individual houses to large historic districts with structures and associated landscape settings, and are distributed as follows in the four towns.

- Bedford contains five historic districts and seven individual properties
- Concord contains eight historic districts (including a portion of the MMNHP) and eighteen individual properties, including six individual National Historic Landmarks
- Lexington contains nine historic districts (including a portion of the MMNHP) and ten individual properties.
- Lincoln contains two historic districts (including a portion of the MMNHP) and four individual properties.

The largest single historic resource is the MMNHP, a National Historic Landmark district with four separate units in Concord, Lexington, and Lincoln that contains numerous historic buildings and places, including individual National Historic Landmarks. The MMNHP is discussed in Section 10.6.

10.4.2 Existing Noise Conditions

All 39 individual properties and 22 historic districts (including MMNHP) listed in the National and State Registers were evaluated in Chapter 7, Noise. The relationship of these properties to 2005 and 2012 noise levels is shown in Figure 10-2. None of the individual properties or historic districts is within the 65 dB DNL contour in 2005 or 2012, which the FAA views as significant noise exposure.

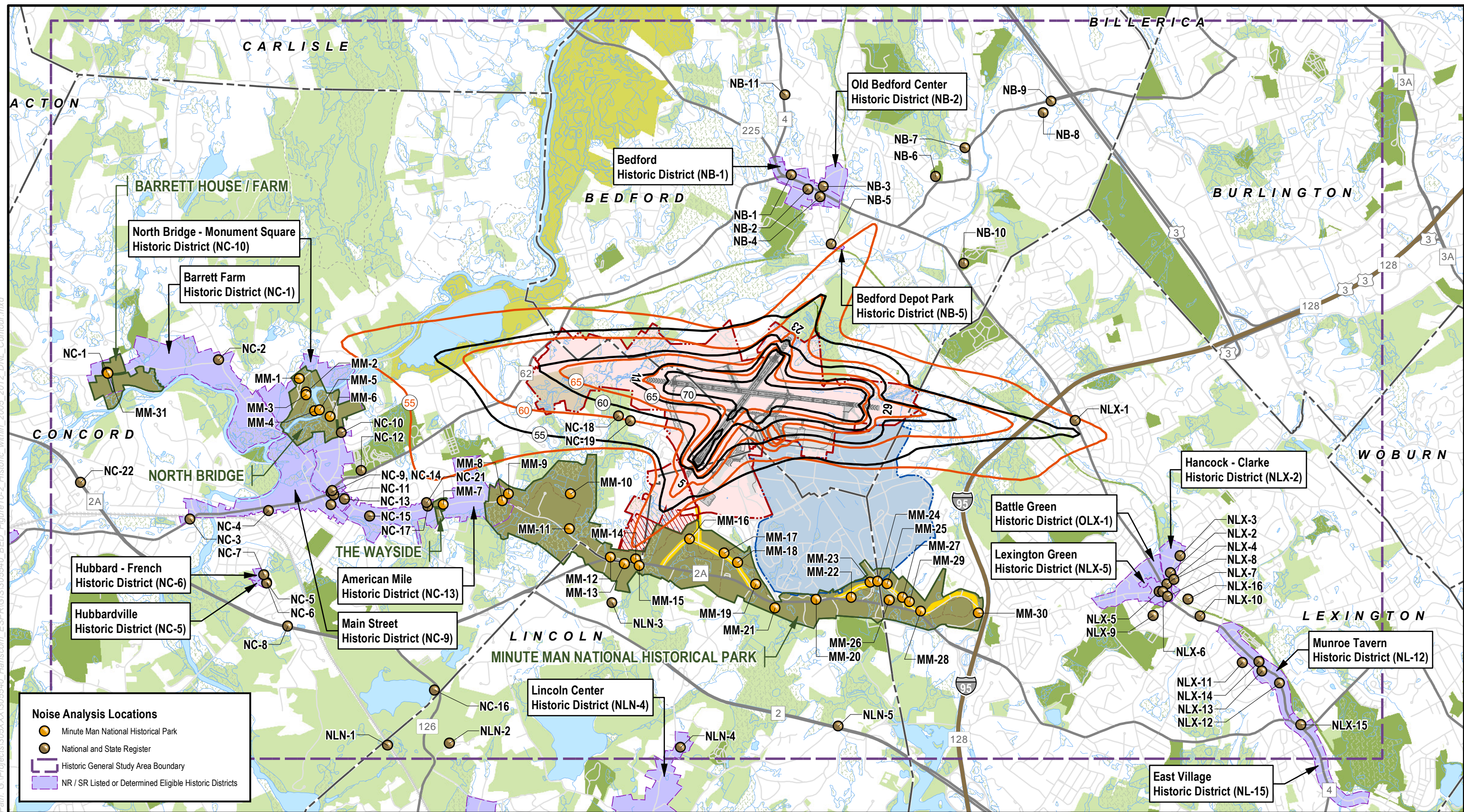
There are no historic districts within the 55 dB DNL contour in 2012 including the MMNHP, discussed below. Two individual National and State Registers properties have DNL values greater than 55 dBA in 2012. These values are 1.7 to 2.0 dB lower than in 2005:

- The Deacon John Wheeler/Capt. Jonas Minot Farmhouse (aka Thoreau Birthplace), 341 Virginia Road in Concord at 58.4 dBA
- The Wheeler-Meriam House, 477 Virginia Road in Concord at 58.1 dBA

One additional property, the Simonds Tavern, 331 Bedford Street in Lexington that was included in this group in 2005 has a value lower than 55 dBA (53) in 2012.

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Data Sources: ESRI (USGS Topographic Maps), March 4, 2013; MassGIS (Community Boundaries), March 5, 2013; PAL, Inc. (Noise Sensitive Receptors), August 28, 2013



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Historic Resources within the 2005 and 2012 DNL Noise Contours

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The highest DNL noise exposure at a historic National and State Registers noise analysis location in 2012 is 58.4 dBA. This level was calculated at the Deacon John Wheeler/Capt. Jonas Minot Farmhouse (aka Thoreau Birthplace). The 2012 value is 2.0 dBA lower than the 2005 value (60.4 dBA), also the highest DNL exposure level for a historic resource in 2005.

Table 10-2 Historic Architectural Resources Listed in the National and State Registers of Historic Places in Bedford

MHC Number	NAL Label ¹	Name	Street Address	Style-Date	National Register/ State Register Status
BED.V	NB-5	Bedford Depot Park Historic District	80 Loomis St. and 120 South Rd.	Eclectic 1874-1877	National Register of Historic Places
BED.A	NB-1	Bedford Historic District	Great Road	Various ca. 1730-1850	Local Historic District
BED.C	NB-2	Old Bedford Center Historic District	Great Road	Various ca. 1730-1860	National Register of Historic Places
BED.K	NB-9	Old Burlington Road-Wilson Mill Area	Old Burlington, Burlington, and Wilson Roads	Various 1676-1924	National Register of Historic Places
BED.D	HB-1	Veterans Administration Medical Center	Springs Road	Georgian Colonial ca. 1920	National Register Determination of Eligibility
BED.21	NB-8	Bacon-Gleason-Blodgett Homestead	118 Wilson Road	Georgian ca. 1750	National Register of Historic Places
BED.23	NB-4	Bedford Old Town Hall	16 South Road	1856	Local Historic District National Register of Historic Places
BED.37	NB-7	Christopher Page House	50 Old Billerica Road	Federal ca. 1730	National Register of Historic Places
BED.17	NB-6	Nathaniel Page House	89 Page Road	First Period 1687	National Register of Historic Places
BED.800	NB-3	Old Burying Ground	7 Springs Road	1729	Local Historic District National Register of Historic Places

Notes:

1. 2012 Noise Analysis Location label.

Table 10-3 Historic Architectural Resources Listed in the National and State Registers of Historic Places in Concord

MHC Number	NAL Label ¹	Name	Street Address	Style-Date	National Register/ State Register Status
CON.DS	NC-13	American Mile Historic District	Lexington Road	Various ca. 1650-1950	Local Historic District
CON.DT	NC-1	Barrett Farm Historic District	Barrett's Mill and Lowell Roads, Liberty Street	Various ca. 1700-1940	Local Historic District
CON.A	NC-14	Concord Monument Square- Lexington Rd Historic District	Monument Square and Lexington Road	Various ca. 1720-1890	National Register of Historic Places
CON.EA	NC-6	Hubbard-French Historic District	324-374 Sudbury Road	Georgian 1787-1950	National Register of Historic Places
CON.DZ	NC-5	Hubbardville Historic District	324-374 Sudbury Road	Georgian 1787-1950	Local Historic District
CON.DU	NC-9	Main Street Historic District	Main St. bet. Monument Sq. and Wood St.	Various 1757-1976	Local Historic District

Notes:

1. 2012 Noise Analysis Location label.

2. See Table 10-13 for historic resources in MMNHP in Concord, Lexington, and Lincoln.

3. Old Manse and The Wayside are individually listed National Historic Landmarks in MMNHP.

4. Walden Pond State Reservation is located in Concord and Lincoln.

Table 10-3 Historic Architectural Resources Listed in the National and State Registers of Historic Places in Concord (continued)

MHC Number	NAL Label ¹	Name	Street Address	Style-Date	National Register/ State Register Status
CON.C CON.DW CON.EC	Multiple	Minute Man National Historical Park	Lexington and North Great Rds., Massachusetts Ave.	Various ca. 1655-1959	National Historic Landmark National Register of Historic Places
CON.DV	NC-10	North Bridge-Monument Square Historic District	Monument Sq., Monument St., Lowell Rd.	Various 1635-1979	Local Historic District
CON.177	NC-18	Deacon John Wheeler-Captain Jonas Minot Farmhouse (Henry David Thoreau Birthplace)	341 Virginia Rd.	Colonial ca. 1730	National Register of Historic Places
CON.405	NC-7	Deacon Thomas Hubbard-Judge Henry French House	342 Sudbury Rd.	Georgian ca. 1787	Local Historic District National Register of Historic Places
CON.241	NC-2	Jonathan Hildreth House	8 Barrett's Mill Rd.	Georgian ca. 1750	Local Historic District National Register of Historic Places
CON.269	NC-3	Joseph Hosmer House	572 Main St.	Colonial 1672	Local Historic District National Register of Historic Places
CON.347 CON.EE	MM-6	Old Manse 3	269 Monument St.	Georgian 1769	Local Historic District National Register of Historic Places National Historic Landmark
CON.170	NC-17	Orchard House	399 Lexington Rd.	Georgian ca. 1750	Local Historic District National Register of Historic Places National Historic Landmark
CON.414	NC-8	Pest House	158 Fairhaven Rd.	Vernacular ca. 1750	National Register of Historic Places
CON.317	NC-15	Ralph Waldo Emerson House	28 Cambridge Turnpike	Greek Revival 1828	Local Historic District National Register of Historic Places National Historic Landmark
CON.802 (CON.DY)	NC-12	Sleepy Hollow Cemetery	24 Court Ln.	Burial Ground 1823	National Register of Historic Places
CON.56	NC-4	Thoreau-Alcott House	255 Main St.	Greek Revival 1820	Local Historic District National Register of Historic Places
CON.936	NC-16	Walden Pond 4	MA Rte. 126	Pond 1845	National Register of Historic Places National Historic Landmark
CON.71 CON.EF	MM-7	The Wayside – Samuel Whitney House 3	455 Lexington Rd.	Colonial ca. 1714	Local Historic District National Register of Historic Places National Historic Landmark
CON.178	NC-19	Wheeler-Meriam House	477 Virginia Rd.	Colonial 1690	National Register of Historic Places
CON.329	NC-11	Wright Tavern	1-8 Lexington Rd.	Georgian 1747	Local Historic District National Register of Historic Places National Historic Landmark

Notes:

1. 2012 Noise Analysis Location label.
2. See Table 10-13 for historic resources in MMNHP in Concord, Lexington, and Lincoln.
3. Old Manse and The Wayside are individually listed National Historic Landmarks in MMNHP.
4. Walden Pond State Reservation is located in Concord and Lincoln.

Table 10-4 Historic Architectural Resources Listed in the National and State Registers of Historic Places in Lexington

MHC Number	NAL Label ¹	Name	Street Address	Style-Date	National Register/ State Register Status
LEX.AQ	Multiple	Minute Man National Historical Park 2	Lexington and North Great Rds., Mass. Ave.	Various ca. 1655-1959	National Register of Historic Places National Historic Landmark
LEX.B	OLX-1	Battle Green Historic District	Worthen Rd., Woburn St., Hastings Rd., Mass. Ave., and B&M Railroad	Various 1713-1960	Local Historic District
LEX.E	NLX-15	East Village Historic District	Massachusetts Ave.	Various ca. 1750-1950	Local Historic District
LEX.C	NLX-2	Hancock-Clarke Historic District	12-41 Hancock St., 3-13 Hancock Ave., 8 Goodwin Rd.	Various 1698-1900	Local Historic District
LEX.AG	NLX-6	Lexington Green	Massachusetts Ave., Harrington Rd., Bedford St.	Town Common 1711	Local Historic District National Register of Historic Places National Historic Landmark
LEX.AC	NLX-5	Lexington Green Historic District	Massachusetts Ave., Bedford St., Harrington Rd.	Various 1713-1960	Local Historic District National Register of Historic Places
LEX.D	NLX-12	Munroe Tavern Historic District	Massachusetts Ave.	Various 1700-1900	Local Historic District
LEX.51 LEX.AH	NLX-7	Buckman Tavern	1 Bedford St.	Georgian ca. 1690	Local Historic District National Register of Historic Places National Historic Landmark
LEX.52	NLX-4	Garrity-Col. John Parkhurst Meriam House	9 Hancock St.	Federal/ Greek Revival ca. 1830	Local Historic District National Register of Historic Places National Historic Landmark
LEX.101	NLX-8	General Samuel Chandler House	8 Goodwin Rd.	Italianate 1846	Local Historic District National Register of Historic Places
LEX.119	NLX-3	Hancock-Clarke House	35 Hancock St.	Colonial 1698	Local Historic District National Register of Historic Places National Historic Landmark
LEX.440	NLX-9	Hancock School	33 Forest St.	Victorian 1890	National Register of Historic Places
LEX.129	NLX-14	John Mason House	1303 Massachusetts Ave.	Federal ca. 1715	Local Historic District National Register of Historic Places
LEX.127 LEX.128	NLX-13	Sanderson House - Munroe Tavern	1314-1332 Massachusetts Ave.	Colonial ca. 1720	Local Historic District National Register of Historic Places
LEX.413	NLX-1	Simonds Tavern	331 Bedford Street	Georgian 1795-1810	National Register of Historic Places
LEX.16	NLX-10	United States Post Office	1661 Massachusetts Ave.	Colonial Revival 1938	National Register of Historic Places
LEX.134	NLX-11	Warren E. Sherburne House	11 Percy Rd.	Eclectic 1893	Local Historic District National Register of Historic Places

Notes:

1. 2012 Noise Analysis Location label.
2. See Table 10-13 for historic resources in MMNHP in Concord, Lexington, and Lincoln.

Table 10-5 Historic Architectural Resources Listed in the National and State Registers of Historic Places in Lincoln

MHC Number	NAL Label ¹	Name	Street Address	Style-Date	National Register/ State Register Status
LIN.A LIN.D	NLN-4	Lincoln Center Historic District	Bedford, Lincoln, Old Lexington, Sandy Pond, Trapelo, and Weston Rds.	Various ca. 1850	Local Historic District National Register of Historic Places
LIN.F LIN.G	Multiple	Minute Man National Historical Park 1	Lexington and North Great Rds., Massachusetts Ave.	Various ca. 1655-1959	National Historic Landmark National Register of Historic Places
LIN.63	NLN-3	Daniel Brooks House	Brooks Rd.	Colonial 1695	National Register of Historic Places
LIN.182	NLN-2	Henry Higginson House	44 Baker Farm Rd.	Tudor Revival 1905	National Register of Historic Places
LIN.60	NLN-5	Hoar Tavern	268 Cambridge Turnpike	Colonial ca. 1713	National Register of Historic Places
LIN.917	NLN-1	Walden Pond 3	MA Rte. 126	Pond 1845	National Register of Historic Places National Historic Landmark
Notes: 1. 2012 Noise Analysis Location label. 2. See Table 10-13 for historic resources in MMNHP in Concord, Lexington, and Lincoln. 3. Walden Pond State Reservation is located in Concord and Lincoln.					

Time Above (TA) is a separate metric that calculates the time during a 24-hour period that aircraft noise exceeds either a threshold level of 65 dBA (TA65) or 55 dBA (TA55). Time Above 65 dBA generally indicates periods when speech interference is possible unless the speaker uses a raised voice. Further detail on Time Above analysis is presented in Chapter 7, Noise.

TA values decreased in 2012 when compared to 2005. TA65 values in 2012 range from 0.1 minute a day at the East Village Historic District in Lexington to approximately 32½ minutes a day at the Wheeler-Meriam House on Virginia Road in Concord (compared to 0.3 and 33.4 in 2005). TA55 values in 2012 range from one-half a minute per day at the East Village Historic District to 113 minutes per day at the Wheeler-Meriam House (compared to 2.9 and 141.7 in 2005).

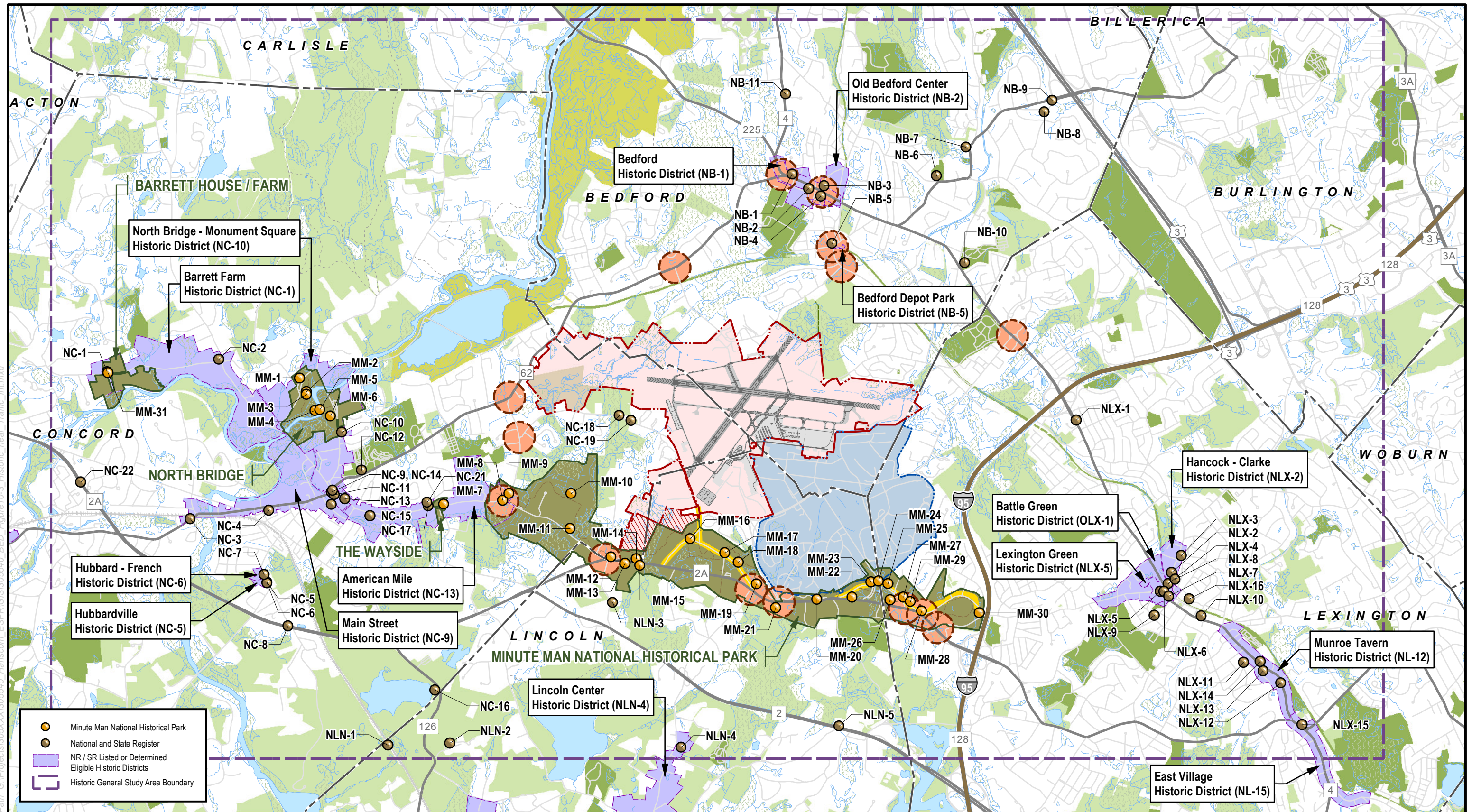
10.4.3 Existing Traffic Conditions

The relationship of National and State Registers properties and the 16 traffic study intersections is shown in Figure 10-3. In accordance with MEPA certificate, traffic associated with Hanscom Field is considered to have a significant impact on an intersection if one or more of the intersection's individual traffic movements consist of ten percent or more of Hanscom Field-related traffic. For the 2012 *ESPR* traffic analysis of 2012 conditions, four intersections triggered this threshold: #5) Hanscom Drive/Old Bedford Road, Lincoln; #6) Hanscom Drive/Route 2A, Lincoln; #10) Old Bedford Road/Virginia Road, Concord; and, #11) Route 62/Old Bedford Road, Concord. National and State Registers-listed historic properties are located near #6) Hanscom Drive/Route 2A, Lincoln, which is next to the MMNHP. Mitigation measures will seek to minimize Hanscom's contribution though no physical modifications are proposed for these intersections.

10.4.4 MHC Inventory

The MHC Inventory is a compilation of inventory forms for historical resources that are typically 50 years old or older. It serves as a basic planning tool for communities and for state and federal agencies in the recording, evaluating, and protecting of historical resources. Resources in the MHC Inventory may not have been formally evaluated and designated as historically significant according to specific

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Data Sources: ESRI (USGS Topographic Maps), March 4, 2013; MassGIS (Community Boundaries), March 5, 2013; PAL, Inc. (Noise Sensitive Receptors), August 28, 2013



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Historic Resources Near Traffic Study Intersections

Figure 10-3

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regulatory criteria, but are properties that may be eligible for inclusion in the National and State Registers. The MACRIS is a computerized database listing of the MHC Inventory that is linked to MassGIS.

Within the general study area comprised of more than 6,000 acres that includes Hanscom Field and adjacent properties, there are extensive entries of historical resources in the MHC Inventory and MACRIS. Appendix G includes the full set of historic resources that was updated for the *2012 ESPR*.⁷¹ Twenty-one of the survey areas and 39 of the surveyed individual properties are also included, wholly or partially, in the State Register. These include the following resources in each town.

- Bedford contains 59 individual historic resources and six survey areas. A National Register nomination is in process for one of these areas: the Old Billerica Road Area in Bedford.
- Concord contains 218 individual historic resources and 38 survey areas. Two of the Concord survey areas are sections of MMNHP.
- Lexington contains 63 individual historic resources and one survey area.
- Lincoln contains no individual historic resources and no survey areas

10.4.5 Existing Noise Conditions

Table 10-6 summarizes by town the number of historic resources in the MHC Inventory and MACRIS that were in the 2012 65 dB DNL and 55 dB DNL contour. None of the historic resources in the MHC Inventory and MACRIS are within the 65 dB DNL contour in 2012, which is consistent with the findings of the *2005 ESPR*. Similarly, for both 2005 and 2012, 13 of the 45 survey areas and 99 of the 340 individual properties are within the 55 dB DNL contour.

Table 10-6 Comparing MHC Inventory and MACRIS Historic Resources within the 65 dBA and 55 dBA DNL Contours for 2005 and 2012

Location ¹	2005 MHC Inventory ¹	2005 ³		2012 MHC Inventory ²	2012 ³	
		65 dBA	55 dBA		65 dBA	55 dBA
AREAS						
Bedford	6	-	5	6	-	5
Concord	38	-	7	38	-	7
Lexington	1	-	1	1	-	1
Lincoln	-	-	-	-	-	0
Total	45	0	13	45	0	13
INDIVIDUAL PROPERTIES						
Bedford	59	-	19	59	-	19
Concord	218	-	47	218	-	47
Lexington	63	-	33	63	-	33
Lincoln	-	-	0	-	-	0
Total	340	0	99	340	0	99
Notes:						
1. Based on research for 2012 <i>ESPR</i> .						
2. Appendix G lists these historic resources.						
3. The numbers of areas listed are fully or partially within the 55 dBA DNL contour.						

⁷¹The full baseline data set covers more than 6,000 acres defined as the general survey area. Appendix G includes Inventory resources that are noise analysis locations in Chapter 7, but were not in the full baseline data set.

10.4.6 Existing Traffic Conditions

Table 10-7 identifies the historic resources listed in the MHC Inventory and MACRIS at the four intersections that were studied for 2012 conditions. As indicated previously, no physical modifications are proposed for these intersections.

10.4.7 Local Historic Commissions

In addition to consulting MHC files and online databases, Massport met with the local historical commissions in Bedford, Concord, Lexington, and Lincoln and with representatives of the MMNHP to explain the purpose and process of the ESPR and to collect updated data on any additional notable historical resources. Each historic commission provided information about historic districts and individual historic resources that are listed or may be eligible for listing in the National and State Registers for consideration as noise analysis locations for the 2012 ESPR noise analysis.

Table 10-7 Historic Architectural Resources in the MHC Inventory and MACRIS near 2012 Intersections

Intersection ¹	MHC Number	Name	Designation ²
#5) Hanscom Dr./Old Bedford Rd. (Lincoln)	None	None	None
#6) Route 2A /Hanscom Dr. (Lincoln)	Multiple	Minute Man National Historical Park	NHL, NR
	LIN.157	Giurleo House	MMNHP
	LIN.158	Giurleo House Garage	MMNHP
#10) Old Bedford Rd./Virginia Rd. (Concord)	CON-BL	Lower Old Bedford Rd./Virginia Rd. Area	MACRIS
	CON.1069	Patrick Dalton House	CON-BL
#11) Old Bedford Rd./Route 62 (Concord)	CON-BN	Old Bedford Road Area II	MACRIS
	CON-BO	Bedford Street Area II	MACRIS
	CON.1090	759 Bedford Street House	CON-BO
Notes: 1. Based on MEPA Scope Certificate for the 2012 ESPR, Hanscom Field traffic is considered to impact an intersection if one or more of the intersection's individual traffic movement(s) consists of ten or more percent Hanscom Field-related traffic. 2. NHL – National Historic Landmark; NR – National Registers of Historic Places; MMNHP – Minute Man National Historical Park; CON-BL/ CON-BO – survey areas in Concord; MACRIS – Massachusetts Cultural Resource Information System.			

Bedford Historical Commission

Bedford noted that two properties that are used as receptors in the noise modeling analysis are now listed in the National and State Registers and that an extension is being proposed for the National Register-listed Old Bedford Historic District.

Concord Historical Commission

Concord provided information about a number of town interests and initiatives. These included interest in the Caesar Robbins House and the initiation of a town-wide archaeological reconnaissance archaeological survey.

Lexington Historical Commission

Lexington described the town's concerns about noise and traffic, and the potential effects to the historic character and the visitor's experience. The town has sponsored several new National Register nomination listings.

Lincoln Historical Commission

Lincoln indicated there are a few mid-twentieth-century modern houses of interest. However, these were already included previously when the 2005 inventory list was prepared.

10.5 Reconnaissance Survey Update

The 2012 *ESPR* provides an update on the reconnaissance-level historic survey that was conducted in March 2006 for the 2005 *ESPR*, consistent with the Secretary of the Interior and MHC standards, to provide preliminary data about historic resources that are eligible to be included in the National and State Registers and/or MHC Inventory. These resources are buildings and neighborhoods that were present in about 1950, but have not previously been surveyed. The reconnaissance survey was conducted within the 2005 55 dB DNL noise contour line that included Hanscom Field, Hanscom AFB, and sections of Bedford, Concord, Lexington, and Lincoln.

The reconnaissance survey update within the smaller 55 dB DNL noise contour line in 2012 identified a total of 54 individual properties and 7 survey areas with historic resources that are 50 years or older. No previously undocumented historic resources were identified at the study intersections during the reconnaissance survey or the update. The survey and update verified that all historic resources at these intersections were already included in the MHC Inventory and MACRIS or the National and State Registers.

10.5.1 Methodology

The historic resources reconnaissance survey update methodology used background data collection including a review of the Massachusetts state inventory files, online Massachusetts Cultural Resource Information System (MACRIS), and the National and State Register files. The most up-to-date information from the towns included updated material on individual properties and one historic district. The NPS provided information on the expansion of the MMNHP by the addition of the new Barrett Farm Unit in Concord.

A drive-by/walkover of the 2012 *ESPR* general study area was completed to identify any changes in historic resources conditions within Hanscom Field and the surrounding communities since the reconnaissance survey in 2006. The field review was conducted within Hanscom Field, the area inside the new 2030 forecast scenario 55 dB DNL noise contour line, and within 200 feet around the 16 traffic study intersections to verify the current status of identified historic resources. In addition, all National and State Register-listed properties outside these defined areas but within the general study area were also field-verified. Information on properties that have been listed in the National or State Register or have reached 50 years of age since 2006, as well as major demolitions, new construction or alterations were recorded in written notes, digital photographs, and on a base map.

The survey update used current Geographic Information System (GIS) mapping, including indicating the boundary of the general study area and reconnaissance study boundary. The locations of National Register properties and historic resources in the MHC Inventory were mapped using the GIS mapping function of the MACRIS online database. The high level of accuracy in current GIS mapping resulted in a few minor corrections to the 2006 survey information. This information is summarized in Appendix G.

Hanscom Field

The reconnaissance survey update completed for the *2012 ESPR* identified a total of nine buildings within Hanscom Field proper that are 50 years old or older. The reconnaissance survey update of Hanscom Field proper identified 10 historic resources that are 50 years old or older. Since the *2005 ESPR*, one historic resource, Hangar 24, has been demolished following an extensive review and approval process, and one building, Hangar 12A, has now reached 50 years of age.

Hanscom Air Force Base

Portions of Hanscom AFB and Massport property leased by the U.S. Air Force are located within the 2012 55 dB DNL contour, including the north one-quarter of the main base. One resource in the general study area, but outside the reconnaissance study boundary, the Air Force Cambridge Research Laboratories Historic District, has been determined eligible for National Register since the *2005 ESPR* (determined eligible 2012). The Bedford Trailer Park (East Section) area off Hartwell Road in Bedford has been demolished by the USAF.

Bedford, Concord, Lexington and Lincoln

The reconnaissance survey update identified six survey areas with approximately five individual properties and portions of three survey areas.

10.5.2 Archaeological Resources

In 2006, an archaeological reconnaissance survey of the Hanscom Field project area in the towns of Bedford, Concord, Lexington, and Lincoln was completed as part of the update for the *2005 ESPR*. The reconnaissance survey was conducted within the Hanscom Field property boundaries and within a 200-foot radius of the 16 traffic study intersections that are described in Chapter 6, Ground Transportation. The primary objectives of the reconnaissance survey were to identify the locations of documented archaeological sites and archaeologically sensitive areas within Hanscom Field and near the traffic study intersections.

The survey included archival research, informant interviews, and a field walkover survey that allowed for the collection of information about known and potential archaeological resource areas. This information was then used to compile environmental and cultural pre-contact and post-contact contexts for the *2005 ESPR* study area in the periods before and after initial European contact with New England, about AD 1500, and to develop sensitivity models for undocumented archaeological sites.

In 2012, a site file review and field walkover were conducted to update recorded archaeological sites within Hanscom Field and near 16 traffic study intersections to assess any environmental changes that have occurred since the 2006 survey.

10.5.3 National and State Registers

A review of the 2013 National and State Registers, site files of the MHC Inventory, and MACRIS maintained by the MHC was completed for the *2012 ESPR* to identify recorded archaeological sites.

within and in proximity to Hanscom Field. The review consulted previously conducted cultural resource management studies conducted within or adjacent to Hanscom Field.^{72,73,74}

One State Register archaeological site was noted in the *1995 GEIR*, the *2000 ESPR*, and in the updated information for the *2005 ESPR* (see Table 10-12). It is a prehistoric period (late Archaic) site in the Town of Lincoln near the intersection of Hanscom Drive and Old Bedford Road. This site is not within the Hanscom Field property.

The 2012 site file review concluded that no new pre- or post-contact archaeological sites have been recorded within the survey area or the traffic study areas since the *2005 ESPR*. There were also no new recorded survey reports listed.

Tables 10-8 through 10-11 list the archeological sites that have been identified in Bedford, Concord, Lexington, and Lincoln. Other than 19-MD-587, none of these sites has been evaluated for eligibility on the State and National Registers. A total of six archaeological sites have been documented either completely or partially within the Hanscom Field boundaries. These include three pre-contact period sites (Pine Hill [19-MD-474], Fox House [19-MD-1028], and Hartwell Farm [19-MD-119]) and three post-contact period sites (Wheeler Mill, Yellow Ochre Mine, and South School). To date, no below-ground archaeological investigations have been conducted for any of these sites and their eligibility for listing in the National Register has not been determined.

Table 10-8 Pre-Contact Archaeological Sites in the MHC Inventory of the Archaeological Assets of the Commonwealth in Bedford near Hanscom Field

MHC Site Number	Site Name	Temporal Association	Site Type
19-MD-77	M-23-54	PaleoIndian	Campsite
19-MD-78	M-23-116	Unknown	Campsite
19-MD-889	Wamesit Crossing	Unknown	Find Spot
19-MD-994	Turf Meadow	Unknown	Lithic Scatter
19-MD-1013	Patriot Place	Unknown	Find Spot
19-MD-1022	Hanscom School Findspot	Middle Archaic	Find Spot
19-MD-1023	Fitch Farm Native American Site	Early Archaic – Late Woodland	Campsite

Table 10-9 Pre-Contact Archaeological Sites in the MHC Inventory of the Archaeological Assets of the Commonwealth in Concord near Hanscom Field

MHC Site Number	Site Name ¹	Temporal Association	Site Type
19-MD-79 19-MD-80	Munson Farm	Late Archaic	Campsite
19-MD-111	Meriam's Corner (MMNHP)	Middle–Late Archaic	Campsite
19-MD-180	Revolutionary Ridge (MMNHP)	Unknown	Campsite
19-MD-472	Pine Hill (Elm Brook Farm)	Unknown	Campsite
19-MD-687	Ox Pasture (MMNHP)	Unknown	Camp
19-MD-946	Fox House	Middle–Late Archaic	Campsite
19-MD-948	Kaveski Farm	Unknown	Find Spot
19-MD-1008	Joshua Brooks	Unknown	Lithic Workshop
19-MD-1010	Vossberg	Unknown	Find Spot
19-MD-1028	Fox House Site	Early–Late Archaic	Listed as “Cultivated field”; likely campsite

⁷²King, Archaeological Reconnaissance Survey of Hanscom Air Force Base, 1992

⁷³Ritchie et al, Archaeological Investigations of Minute Man National Historical Park, 1990.

⁷⁴Herbster, Archeological Overview and Assessment, Minute Man National Historical Park, Concord, Lincoln, and Lexington, Massachusetts, 2005.

MHC Site Number	Site Name ¹	Temporal Association	Site Type
	Job Brooks Number 1 (MMNHP)	Unknown	Activity Area/Camp
	Job Brooks Number 2 (MMNHP)	Unknown	Activity Area/Camp
	Job Brooks Number 3 (MMNHP)	Unknown	Activity Area/Camp
Note: 1. MMNHP – Minute Man National Historical Park			

Table 10-10 Pre-Contact Archaeological Sites in the MHC Inventory of the Archaeological Assets of the Commonwealth in Lexington near Hanscom Field

MHC Site Number	Site Name ¹	Temporal Association	Site Type
19-MD-685	Thomas Nelson Jr. Farm P1 (MMNHP)	Unknown	Activity Area
19-MD-688	Jacob Whittemore Farm P1 (MMNHP)	Middle Archaic	Campsite/workshop
Note: 1. MMNHP – Minute Man National Historical Park			

Table 10-11 Pre-Contact Archaeological Sites in the MHC Inventory of the Archaeological Assets of the Commonwealth in Lincoln near Hanscom Field

MHC Site Number	Site Name ¹	Temporal Association	Site Type
19-MD-119	Hartwell Farm	Woodland	Campsite
19-MD-587	Black Rabbit ²	Late/Transitional Archaic	Campsite (fall/winter)
19-MD-588	Black Walnut	Unknown	Campsite
19-MD-589	Perk Site	Unknown	Chipping Station
19-MD-676	William Smith Farm P2 (MMNHP)	Unknown	Campsite
19-MD-677	Joshua Brooks Farm P1 (MMNHP)	Unknown	Campsite
19-MD-678	Ephraim Hartwell Farm P4 (MMNHP)	Unknown	Campsite
19-MD-679	Ephraim Hartwell Farm P3 (MMNHP)	Unknown	Campsite
19-MD-680	William Smith Farm P1 (MMNHP)	Unknown	Campsite
19-MD-681	Aaron Brooks Farm P1 (MMNHP)	Unknown	Campsite
19-MD-682	Ephraim Hartwell Farm P2 (MMNHP)	Unknown	Campsite
19-MD-683	Ephraim Hartwell Farm P1 (MMNHP)	Unknown	Campsite
19-MD-684	Thomas Nelson Jr. Farm P2 (MMNHP)	Unknown	Campsite
19-MD-686	Holt Pasture (MMNHP)	Unknown	Campsite
19-MD-995	Block 2	Unknown	Find Spot
19-MD-996	Captain W. Smith House Findspot 1 (MMNHP)	Unknown	Find Spot
19-MD-997	Rogers Property (MMNHP)	Middle–Late Archaic	Flake Scatter
19-MD-1006	Joseph Mason Site (MMNHP)	Unknown (possibly Woodland)	Campsite
Notes: 1. MMNHP – Minute Man National Historical Park 2. The Black Rabbit Site has a State Preservation Restriction.			

10.5.4 Reconnaissance Survey

The 2006 reconnaissance archaeological survey found that a few relatively undisturbed portions of Hanscom Field exist, including tracts of woodland peripheral to the runways, terminal, and supporting facilities. These areas generally contain secondary growth woodlands with both deciduous and coniferous species of trees. Interspersed are wetland areas and some drainage improvements/alterations to the existing waterways.

Most of Hanscom Field, however, has been previously disturbed by construction. Disturbance activities include landfilling, installation of utilities, and construction of buildings, parking lots, roadways, and runways. Areas of high pre-contact archaeological sensitivity in the project area include previously undisturbed, dry, level areas located adjacent to the natural brooks and wetlands in the peripheral portions of the project area. The extreme southern portion of Hanscom Field and the intersections along Route 2A

have moderate to high archaeological sensitivity for post-contact resources associated with the April 19, 1775 engagement along Battle Road, now part of the MMNHP.

The 2012 field walkover noted one area where new development has occurred since the 2006 reconnaissance survey. The Edge Sports Center opened in 2007 and two outdoor turf fields are now located in the previous trailer park on the north side of Hartwell Road. There are currently two full size outdoor turf fields that are utilized for soccer, lacrosse and field hockey. During the 2006 survey, this portion of the North Airfield Area contained an existing trailer park campground facility adjacent to Hartwell Road. This portion of the project area was assigned high archaeological sensitivity for pre-contact period resources and moderate archaeological sensitivity for post-contact period resources, based on the presence of a wooded area immediately west of the trailer park. More detailed information collected as part of the 2012 ESPR update determined that the wooded area is located outside of the project area and that the portion of the Edge Sports Center located within the project area was constructed in the previously developed/disturbed trailer park. As a result of this updated information, this portion of the North Airfield was re-designated as a low sensitivity area for both pre and post-contact archaeological resources.

No other portions of the Hanscom Field study area or any areas managed by the Transportation Security Agency (TSA) (e.g. airside secure areas) have undergone new development since the 2006 reconnaissance survey and the sensitivity for these areas remains the same.

10.5.5 Proximity of Sites to Traffic Study Intersections

As presented in Table 10-12, a total of 27 archaeological sites have been documented within a 200 foot-radius at nine of the 16 traffic study intersections. This total includes 15 pre-contact and 12 post-contact period sites. Twenty of the twenty-seven recorded sites are located within the boundaries of the MMNHP. Thirteen of the intersections were determined to have areas that are undisturbed, defined as no obvious signs of previous ground disturbance, except for the immediate intersection right-of-way. The condition of three intersection areas was assessed as unknown due to intersection improvements.

10.6 Minute Man National Historical Park

MMNHP is operated by the NPS. Since 1959, when MMNHP was created within the towns of Concord, Lexington, and Lincoln, the Park and Hanscom have been neighbors. As two regionally and nationally significant land uses, MMNHP and Hanscom Field encounter both shared investment in the improvement of the region and the need for visitor access. Massport met with the NPS on May 23, 2013 to solicit input on the 2012 ESPR and communicate periodically to discuss Hanscom Field and its relationship to MMNHP.

10.6.1 Visitation Levels

More than one million people visit the facilities and attend the programs of MMNHP annually. The park is recognized as an important asset to the region and the nation. The park sits in the suburbs of a major metropolitan area with modern, vibrant and expanding residential, industrial and commercial sectors. While the park is open year-round, its main season is the seven-month period between April and October.

Major attractions are the North Bridge area in Concord and the Visitor Center off North Great Road in the Battle Road Park unit in Lincoln. Two parking lots at the North Bridge unit and one at the Visitor Center accommodate auto and bus parking; six other parking lots are located in the Park. The early spring,

starting with Patriot's Day in Massachusetts, represents the first major influx of park visitors. Fall foliage season is the other very popular period. The park is open daily from sun-up to sundown, but buildings are generally open from 9 a.m. to 5 p.m.

10.6.2 Overview of Park

MMNHP is the largest National and State Registers resource in the vicinity of Hanscom Field. It consists of four discontinuous sections referred to as the Battle Road, Wayside, North Bridge and Barrett Farm Units, which are illustrated in Figures 10-4 and 10-5. The Col. Barrett Farm Unit in Concord, which is individually listed in the National Register as the Col. James Barrett House, is an addition to the MMNHP since the 2005 *ESPR*. It was authorized in 2009 and completed in 2012. The park covers approximately 967 acres along Route 2A in Concord, Lexington, and Lincoln and off Monument Street in Concord, plus an additional 3.4 acres in the new Barrett Farm Unit.

When Congress created MMNHP in 1959, Hanscom Field had already been operating for 18 years, having been established by the Commonwealth in 1941. A portion of the Congressional boundaries of the park, comprising 50 acres in Lincoln, is within Massport land at the southwest area of Hanscom Field. There are no buildings or structures on this wooded parcel.

Table 10-12 Archaeological Resources at Traffic Study Intersections

Intersection	Archaeological Sites ¹	Condition ²
#1) Route 4-225/Hartwell Ave. (Lexington)	None documented	Unknown/intersection improvements
#2) Mass. Ave./Rte 2A (Lexington)	None documented	Unknown/intersection improvements
#3) Old Mass. Ave./Rte. 2A (Lexington)	19-MD-688 (MMNHP) LEX-HA-13 (MMNHP) LEX-HA-15 (MMNHP)	Undisturbed
#4) Airport Rd./Rte. 2A (Lexington)	19-MD-684 (MMNHP) 19-MD-685 (MMNHP) 19-MD-688 (MMNHP) LEX-HA-12 (MMNHP) LEX-HA-13 (MMNHP)	Undisturbed
#5) Hanscom Dr./Old Bedford Rd. (Lincoln)	19-MD-587	Unknown/intersection improvements
#6) Hanscom Dr./Rte. 2A (Lincoln)	19-MD-678 (MMNHP) 19-MD-679 (MMNHP) 19-MD-682 (MMNHP) 19-MD-683 (MMNHP)	North Side = disturbed (recent construction for pedestrian underpass); South Side= Undisturbed
#7) Bedford Rd./Rte. 2A (Lincoln)	19-MD-681 (MMNHP) 19-MD-996 (MMNHP) LIN-HA-54 (MMNHP)	Undisturbed
#8) Cambridge Tpke. Cut-Off/Brooks Rd./Rte. 2A (Concord/Lincoln)	19-MD-997 (MMNHP) Samuel Brooks House Site (MMNHP) Brooks Hill Fight Sight (MMNHP)	Undisturbed
#9) Old Bedford Rd./Lexington Rd. (Concord)	19-MD-111 (MMNHP) 19-MD-180 (MMNHP) CON-HA-26	Undisturbed
#10) Old Bedford Rd./Virginia Rd. (Concord)	None documented	Undisturbed; possible house lot/landscaping disturbance
#11) Old Bedford Rd./Rte. 62 (Concord)	None documented	Mostly Undisturbed Possible House Lot/Landscaping Disturbance West=Recently Disturbed
#12) Hartwell Rd./Rte. 62 (Bedford)	None documented	Undisturbed; possible house lot/landscaping disturbance
#13) South Rd./Hartwell Rd. (Bedford)	None documented	Undisturbed; possible house lot/landscaping disturbance
#14) Rte. 4-225/Rte. 62 (Bedford)	None documented	Undisturbed; possible house lot/landscaping disturbance
#15) Rte. 4-225/Springs Rd./South Rd. (Bedford)	19-MD-1013 BED-HA-05	West Side= Undisturbed; possible house lot/landscaping disturbance;

Intersection	Archaeological Sites ¹	Condition ²
	BED-HA-09 BED-HA-10 Old Bedford Center NRDIS Bedford Local Historic District	East Side = Disturbed/modern period construction
#16) South Rd./Loomis St./Railroad Ave. (Bedford)	BED-HA-21 Bedford Depot Park NRDIS	Some disturbance/intersection improvements/parking lots
Notes: 1. MMNHP – Minute Man National Historical Park; NRDIS – National Register Historic District. 2. Undisturbed (no obvious signs of previous disturbance) except for immediate intersection right-of-way.		

MMNHP itself and a number of individual historic properties within the Park are historic resources of national significance that are designated National Historic Landmarks. The Park is nationally significant as the site of the Battle of Concord, one of the two battles that marked the beginning of the Revolutionary War; for its association with prominent literary figures of the nineteenth and twentieth centuries; and as one of the earliest places in the nation to be commemorated. The Park was created to " . . . provide . . . for the preservation and interpretation of historic sites, structures, and properties lying along the entire route of battle" in April 1775.

10.7 Battle Road Unit

The Battle Road Unit, the largest unit, covers approximately 849 acres and stretches five miles along present-day Route 2A, consisting of Lexington Road (Concord), North Great Road (Lincoln), and Massachusetts Avenue (Lexington). At the time of the battle, as today, the road was a much traveled regional route that linked the town of Concord with Cambridge, Boston, and the sea. Some sections of the Battle Road have been restored to their unpaved appearance, while others form parts of the paved automobile road (Route 2A). The original route is readily discernible and is lined almost continuously with stone walls in the central and eastern parts of the park unit. Hanscom Field, Hanscom AFB, and its associated military housing abut the northern boundary of the eastern half of the Battle Road Unit. Modern residential developments line much of the southern boundary, and the interstate highway and commercial/office developments mark the east terminus at Route 128/I-95.

Six of the 16 traffic study intersections are located within the Battle Road Unit of the MMNHP. All of the areas around the intersections encompass historic farming and/or wooded landscapes, and five contain historic buildings.

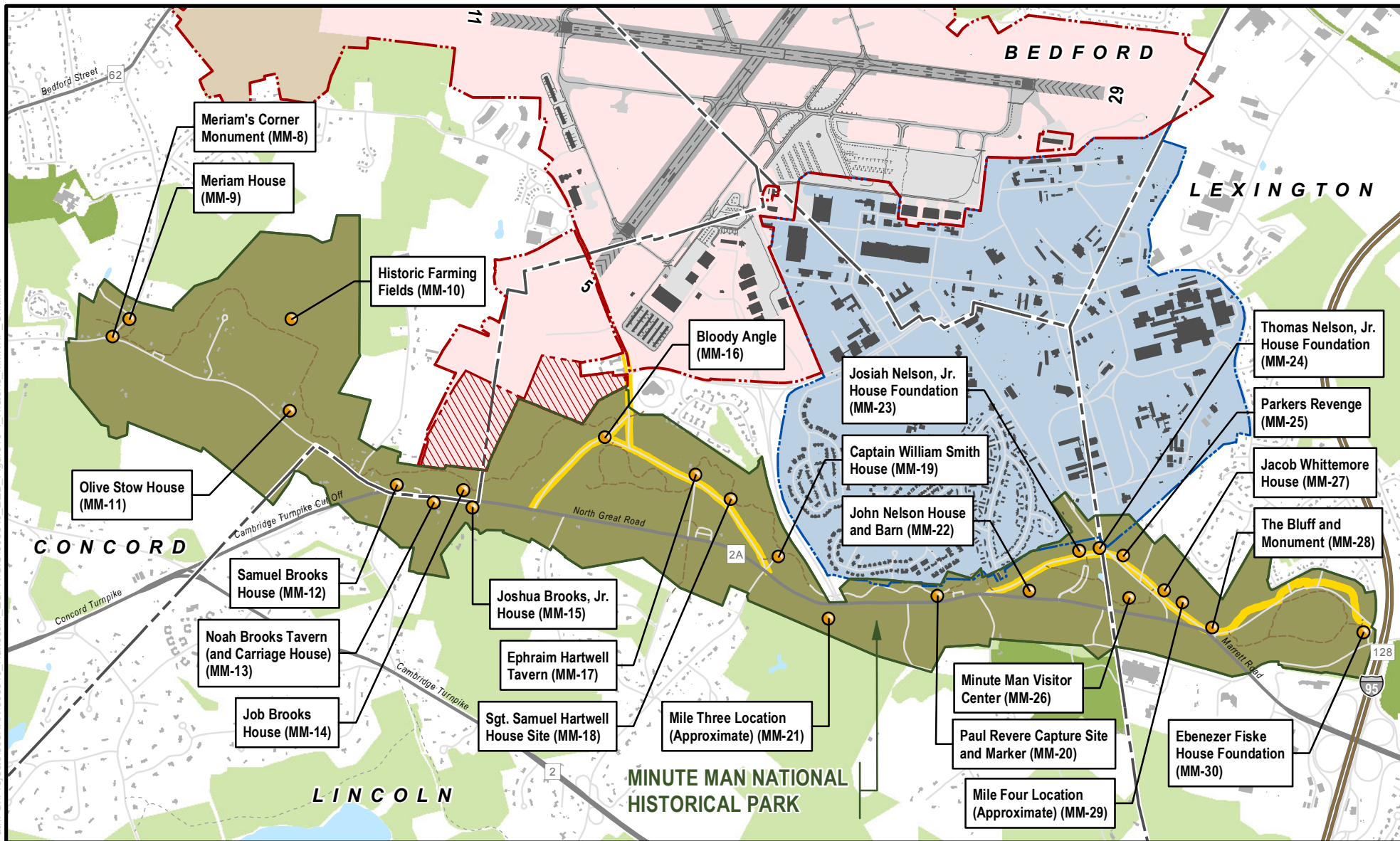
10.8 The Wayside Unit

The Wayside Unit is the smallest section, containing approximately six acres on the north side of Route 2A in Concord. This unit centers around The Wayside, the home of three notable American authors: Louisa May Alcott, Nathaniel Hawthorne, and Margaret Sidney.

10.9 North Bridge Unit

The North Bridge Unit contains approximately 112 acres in Concord and is crossed by the Concord River. It contains the North Bridge where, on April 19, 1775, Colonial militia men fired the famous "shot heard 'round the world." The surrounding tranquil, commemorative landscape includes Daniel Chester French's Minute Man Statue.

Path: G:\Projects\305540\Hanscom ESPR\GIS\305540_BED_Figure10-4_Historic MMNHP Unit.mxd



- Minute Man National Historical Park Resource
- Hanscom Field Property Boundary
- Massport Property within MMNHP Congressional Boundary
- Hanscom AFB Property Boundary
- Municipal Boundary
- Historic Battle Road
- Battle Road Trail
- Interstate
- Highway
- Road
- Active Rail Service
- MMNHP Boundary
- Open Space Non-protected
- Open Space Protected in Perpetuity
- Open Water



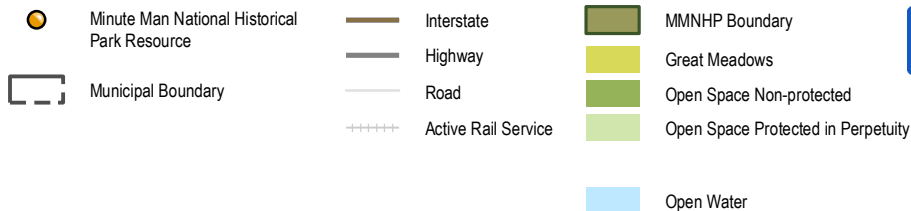
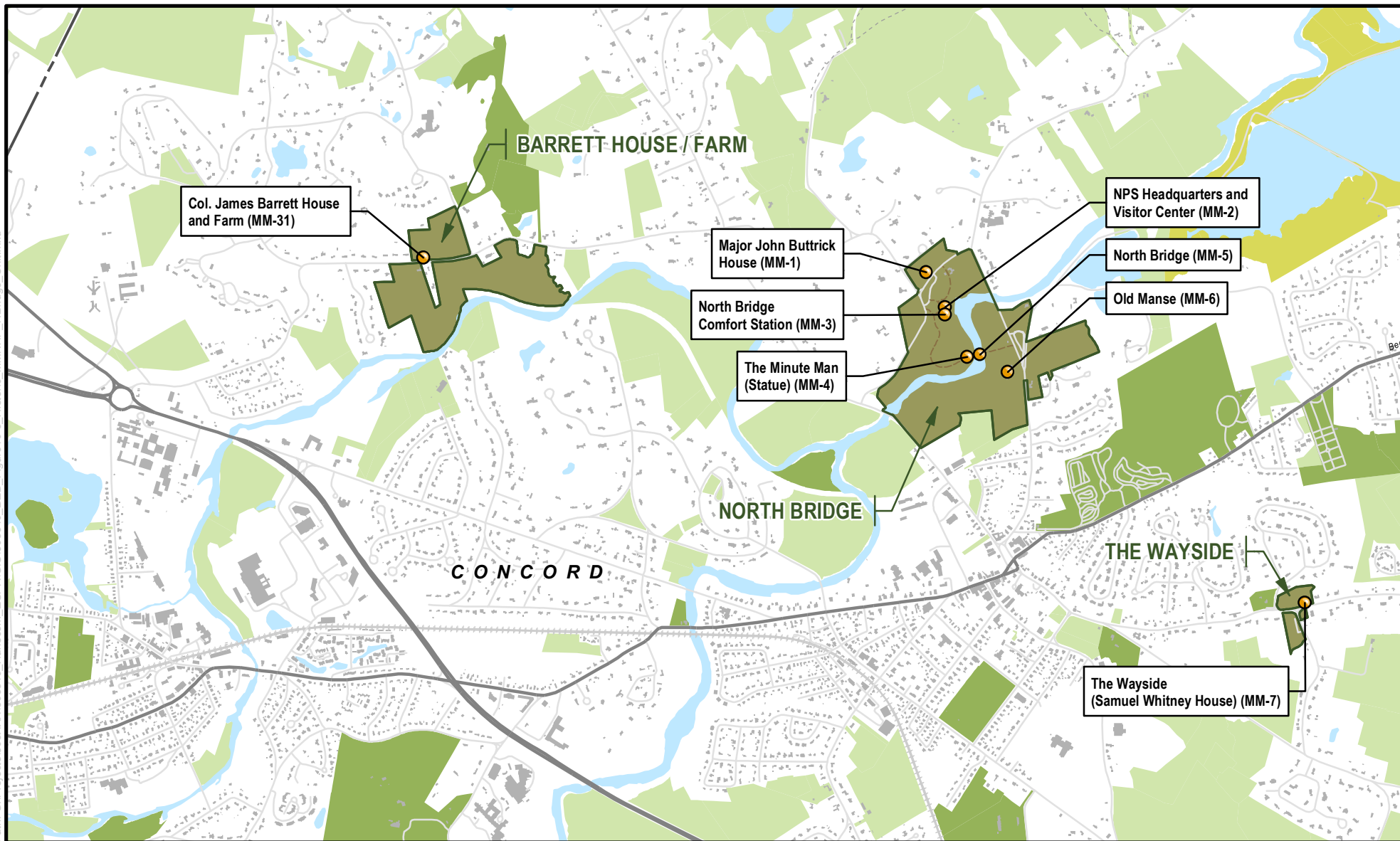
Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Historic Resources MMNHP Battle Road Unit

Data Sources: ESRI (USGS Topographic Maps), March 4, 2013;
MassGIS (Community Boundaries), March 5, 2013;
PAL, Inc. (Noise Sensitive Receptors), August 28, 2013

Figure 10-4

Path: G:\Projects\305XXX\305540_Hanscom_ESPR\GIS\305540_BED_Figure10-5_Historic_MMNHP_NBridge_Unit.mxd



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Historic Resources MMNHP North Bridge and Barrett Farm

Figure 10-5

10.10 Barrett Farm Unit

The Barrett's Farm Unit contains the Col. James Barrett Farm and 3.4 acres of land at 448 Barrett's Mill Road in Concord. Built in 1705, it was the house of James Barrett, a Colonel of the Concord, Massachusetts Militia during the Battles of Lexington and Concord on April 19, 1775, and a site where colonial militia munitions were stored.

10.11 Park Environs and Landscape Features

The MMNHP landscapes and habitats are dominated by forests that cover approximately 500 acres, including about 200 acres of forested wetlands. Non-forested wetlands, including several ponds, constitute approximately 180 acres within the park. Open meadows and fields cover an additional 250 acres, including approximately 100 acres that are farmed under the park's agricultural leasing program. Shrublands characterize the interface of fields and forests. The remainder of the park contains developed areas, including roads, parking lots, and buildings.

The park today is generally characterized by low-density residential development set in a landscape of open pastures, interspersed with woodland and marshes. However, as noted in the updated National Register nomination dated 2001, areas within the present-day park underwent significant change between 1775 and 1959. The area remained agricultural well into the nineteenth century, but intensive residential development occurred as the area became part of Boston's commuting community during the early and mid-twentieth century. The improvement of existing roads, such as Route 2 and Route 2A for the automobile in the 1920s and 1930s and also the creation of Route 128/I-95 regional highway in the 1950s, supported local growth. This suburbanization trend continues today around the park. Within the park, as part of its mission to preserve and interpret individual resources that contribute to understanding the site's historical events, the NPS removed approximately 200 structures and nearly 100 percent of commercial development. These reclaimed open spaces provide a backdrop for the remaining historical resources.

10.12 Historic and Archaeological Resources in Minute Man National Historical Park

Included in the MMNHP boundaries are numerous historic buildings, structures, sites, and landscapes. Many of the key historic resources and areas within the park are shown on Figures 10-4 and 10-5 and are summarized in Table 10-13. The NPS completed a comprehensive inventory of all resources in MMNHP as part of an updated National Register nomination.⁷⁵ The NPS inventory identified a total of 105 resources that contribute to the historic significance of the park, as well as 24 resources that do not contribute, primarily due to their recent age. The Col. James Barrett Farm has been added to this list as part of the 2012 *ESPR* update. The complete NPS inventory for the park is included in Appendix G.

Extant historic farming fields in the park are dominantly clustered at the west end of the Battle Road Unit between the Farwell Jones and the Olive Stow houses and Meriam's Corner in Concord. Smaller fields also remain at the Trainor field and Fiske Hill fields in Lexington, and at fields near Bloody Angle and the Hartwell Tavern in Lincoln.

⁷⁵Harrington et al. (PAL), Minute Man National Historical Park National Register of Historic Places Nomination, 2001

An archaeological overview and assessment of MMNHP, with emphasis on the Battle Road Unit, was completed in 2005.⁷⁶ This study reports that MMNHP contains documented archaeological resources that date from approximately 9,000 years before present to the early twentieth century. More than 100 prehistoric and historic period archaeological sites have been identified within the park, and there is a high probability of additional sites being present in most areas.

10.13 General Management Plan

The 2000 *ESPR* reported that the 1989 General Management Plan (GMP) for MMNHP had largely been implemented. These facilities include new parking areas to better control traffic and accommodate visitors, and improvements by the Massachusetts Highway Department to the appearance of the paved sections of the Battle Road on Lexington Road and Route 2A, as well as installation by NPS of appropriate, limited signage, landscaping and rebuilt stone walls that enhance the visual experience of the park.

Table 10-13 Key Resources in the Minute Man National Historical Park

Town	MHC Number	2005 Noise Label	Street Address	Name	Style-Date	NR/SR Status ¹
BATTLE ROAD UNIT						
Concord, Lexington, Lincoln	NA 2	Multiple	Along and off Massachusetts Avenue and Lexington Road	Battle Road	18th-20th centuries	Contributing
Concord, Lexington, Lincoln	NA	Multiple	Off Massachusetts Avenue and Lexington Road	Battle Road Trail	1996-2001	Non-Contributing
Concord	NA	MM-10	Off Route 2A	Historic Farming Fields	18th-20th centuries	Contributing
Concord	CON.9015	MM-8	Old Bedford Road	Meriam's Corner Monument	1885	Contributing
Concord	CON.350	MM-9	34 Old Bedford Road	Meriam House	ca. 1705, ca. 1725	Contributing
Concord	CON.357	MM-11	965 Lexington Road	Olive Stow House/Farwell Jones House/Carty Barn	Colonial - ca. 1760	Contributing
Concord	CON.358	MM-12	1175 Lexington Road	Samuel Brooks House	ca. 1692-1728	Contributing
Lexington	LEX.929	MM-28	Old Massachusetts Avenue and Wood Street	Bluff Monument	1885	Contributing
Lexington	NA	MM-30	Old Massachusetts Avenue and Wood Street	Ebenezer Fiske House Foundation	ca. 1729-late 19th century	Contributing
Lexington	NA	MM-29	Off Route 2A	Historic Farming Fields	18th-20th centuries	Contributing
Lexington	LEX.618 LEX.1536	MM-27	21 Marrett Street	Jacob Whittemore House/John Muzzey House and Hargrove/Whittemore Barn	Georgian-1745 (Barn-1850)	Contributing
Lexington	NA	MM-26	Massachusetts Avenue	Minute Man Visitors Center	Modern-1976	Non-Contributing
Lexington	NA	MM-25	Off Massachusetts Avenue, Fiske Hill	Parkers Revenge	1775	Contributing

⁷⁶Herbster (PAL), Archeological Overview and Assessment, Minute Man National Historical Park, Concord, Lincoln, and Lexington, Massachusetts, 2005

Town	MHC Number	2005 Noise Label	Street Address	Name	Style-Date	NR/SR Status ¹
			and Concord Hill			
Lincoln	NA	MM-16	Off Lexington Road	Bloody Angle	1775	Contributing
Lincoln	LIN.70	MM-19	Virginia Road	Captain William Smith House	Colonial – ca. 1750	Contributing
Lincoln	LIN.66	MM-17	Virginia Road	Ephraim Hartwell Tavern	Colonial-1733	Contributing
Lincoln	NA	MM-21	Off Route 2A	Historic Farming Fields	18th-20th centuries	Contributing
Lincoln	NA	MM-14	North Great Road	Job Brooks House	Colonial-1740	Contributing
Lincoln	LIN.170 LIN.171	MM-22	200 Massachusetts Avenue	John Nelson House and Barn	Federal-1808, 1810	Contributing
Lincoln	LIN.65	MM-15	37 North Great Road	Joshua Brooks, Jr. House	Federal-1780	Contributing
Lincoln	LIN.929	MM-23	Nelson Road	Josiah Nelson, Jr. House Foundation	ca. 1775	Contributing
Notes:						
1. NR – National Register of Historic Places; SR – State Register of Historic Places						
2. N/A – Not Applicable						
3. Old Manse and The Wayside are individually listed National Historic Landmarks that are also located within MMNHP						

Table 10-13 Key Resources in the Minute Man National Historical Park (continued)

Town	MHC Number	2005 Noise Label	Street Address	Name	Style-Date	NR/SR Status ¹
BATTLE ROAD UNIT (continued)						
Lincoln	LIN.64	MM-13	33 North Great Road	Noah Brooks Tavern (and Carriage House)	Federal-ca. 1798	Contributing
Lincoln	LIN.940	MM-20	Massachusetts Avenue	Paul Revere Capture Site and Marker	pre 1902	Contributing
Lincoln	LIN.69	MM-18	Virginia Road	Sgt. Samuel Hartwell House Site	1693-1716; burned 1968; shelter 1986	Contributing
Lincoln	LIN.941	MM-24	Nelson Road	Thomas Nelson, Jr. House Foundation	1700-1750	Contributing
NORTH BRIDGE UNIT						
Concord	CON.343	MM-1	231 Liberty Street	Major John Buttrick House	ca. 1715; 19th century alterations	Contributing
Concord	CON.941	MM-4	Liberty Street	The Minuteman (Statue)	1875	Contributing
Concord	CON.940	MM-5	Monument Street	North Bridge	1956	Contributing
Concord	NA	MM-3	Monument Street	North Bridge Comfort Station	No Style-1984	Non-Contributing
Concord	CON.347	MM-6	269 Monument Street	Old Manse 3	Colonial-1769-1770	Contributing
Concord	CON.344	MM-2	174 Liberty Street	Steadman Buttrick House (NPS Headquarters and Visitor Center)	Colonial Revival- 1911	Contributing
WAYSIDE UNIT						
Concord	CON.171	MM-7	455 Lexington Road	The Wayside 3 (Samuel Whitney House)	Colonial/Victorian Eclectic-1716-17; altered mid-1840s; 1860/70	Contributing
BARRETT FARM UNIT						
Concord	CON.256	--	448 Barrett's Mill Road	Col. James Barrett Farm	Colonial-1705	Contributing
Notes:						

Town	MHC Number	2005 Noise Label	Street Address	Name	Style-Date	NR/SR Status ¹
1. NR – National Register of Historic Places; SR – State Register of Historic Places						
2. N/A – Not Applicable						
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Table 10-13 Key Resources in the Minute Man National Historical Park (continued)

Town	MHC Number	2005 Noise Label	Street Address	Name	Style-Date	NR/SR Status ¹
BATTLE ROAD UNIT						
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Concord, Lexington, Lincoln	NA	Multiple	Off Massachusetts Avenue and Lexington Road	Battle Road Trail	1996-2001	Non-Contributing
Concord	NA	MM-10	Off Route 2A	Historic Farming Fields	18th-20th centuries	Contributing
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Concord	CON.350	MM-9	34 Old Bedford Road	Meriam House	ca. 1705, ca. 1725	Contributing
Concord	CON.357	MM-11	965 Lexington Road	Olive Stow House/Farwell Jones House/Carty Barn	Colonial - ca. 1760	Contributing
Concord	CON.358	MM-12	1175 Lexington Road	Samuel Brooks House	ca. 1692-1728	Contributing
Lexington	LEX.929	MM-28	Old Massachusetts Avenue and Wood Street	Bluff Monument	1885	Contributing
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Lexington	NA	MM-29	Off Route 2A	Historic Farming Fields	18th-20th centuries	Contributing
Lexington	LEX.618 LEX.1536	MM-27	21 Marrett Street	Jacob Whittemore House/John Muzzey House and Hargrove/Whittemore Barn	Georgian-1745 (Barn-1850)	Contributing
Lexington	NA	MM-26	Massachusetts Avenue	Minute Man Visitors Center	Modern-1976	Non-Contributing
Lexington	NA	MM-25	Off Massachusetts Avenue, Fiske Hill and Concord Hill	Parkers Revenge	1775	Contributing
Lincoln	NA	MM-16	Off Lexington Road	Bloody Angle	1775	Contributing
Lincoln	LIN.70	MM-19	Virginia Road	Captain William Smith House	Colonial – ca. 1750	Contributing
Lincoln	LIN.66	MM-17	Virginia Road	Ephraim Hartwell Tavern	Colonial-1733	Contributing
Lincoln	NA	MM-21	Off Route 2A	Historic Farming Fields	18th-20th centuries	Contributing
Lincoln	NA	MM-14	North Great Road	Job Brooks House	Colonial-1740	Contributing
Lincoln	LIN.170 LIN.171	MM-22	200 Massachusetts Avenue	John Nelson House and Barn	Federal-1808, 1810	Contributing
Lincoln	LIN.65	MM-15	37 North Great Road	Joshua Brooks, Jr. House	Federal-1780	Contributing
Lincoln	LIN.929	MM-23	Nelson Road	Josiah Nelson, Jr. House Foundation	ca. 1775	Contributing
Notes:						
1. NR – National Register of Historic Places; SR – State Register of Historic Places						

2. N/A – Not Applicable
 3. Old Manse and The Wayside are individually listed National Historic Landmarks that are also located within MMNHP

Table 10-13 Key Resources in the Minute Man National Historical Park (continued)

Town	MHC Number	2005 Noise Label	Street Address	Name	Style-Date	NR/SR Status ¹
BATTLE ROAD UNIT (continued)						
Lincoln	LIN.64	MM-13	33 North Great Road	Noah Brooks Tavern (and Carriage House)	Federal-ca. 1798	Contributing
Lincoln	LIN.940	MM-20	Massachusetts Avenue	Paul Revere Capture Site and Marker	pre 1902	Contributing
Lincoln	LIN.69	MM-18	Virginia Road	Sgt. Samuel Hartwell House Site	1693-1716; burned 1968; shelter 1986	Contributing
Lincoln	LIN.941	MM-24	Nelson Road	Thomas Nelson, Jr. House Foundation	1700-1750	Contributing
NORTH BRIDGE UNIT						
Concord	CON.343	MM-1	231 Liberty Street	Major John Buttrick House	ca. 1715; 19th century alterations	Contributing
Concord	CON.941	MM-4	Liberty Street	The Minuteman (Statue)	1875	Contributing
Concord	CON.940	MM-5	Monument Street	North Bridge	1956	Contributing
Concord	NA	MM-3	Monument Street	North Bridge Comfort Station	No Style-1984	Non-Contributing
Concord	CON.347	MM-6	269 Monument Street	Old Manse 3	Colonial-1769-1770	Contributing
Concord	CON.344	MM-2	174 Liberty Street	Steadman Buttrick House (NPS Headquarters and Visitor Center)	Colonial Revival- 1911	Contributing
WAYSIDE UNIT						
Concord	CON.171	MM-7	455 Lexington Road	The Wayside 3 (Samuel Whitney House)	Colonial/Victorian Eclectic-1716-17; altered mid-1840s; 1860/70	Contributing
BARRETT FARM UNIT						
Concord	CON.256	--	448 Barrett's Mill Road	Col. James Barrett Farm	Colonial-1705	Contributing
Notes: 1. NR – National Register of Historic Places; SR – State Register of Historic Places 2. N/A – Not Applicable 3. Old Manse and The Wayside are individually listed National Historic Landmarks that are also located within MMNHP						

The NPS has indicated to Massport that annual visitations at MMNHP are currently stabilized at levels of about one million, and that little, if any, expansion of park boundaries or buildings is planned. Individual programs at various sites within the park continue to be advertised to attract audiences, but general promotions to encourage large increases in total attendance are not part of the current or future management plans.

In 2005, the NPS had begun to develop the preliminary scope for a new General Management Plan. This planning process is ongoing. The scope of the plan and ongoing work in the park focuses on several areas. The preservation, rehabilitation, and adaptive reuse of historic structures addresses cyclical and deferred maintenance needs and should improve the visitor experience. Landscape enhancements include supporting active agricultural uses and incorporating interpretive opportunities through clearing of historic farming fields and leasing them for cultivation.

The NPS was also completing review of archaeological resources and conducting mammal and vegetative studies. An important focus of the plan is transportation, safety, and access for visitors and employees in the Battle Road Unit, which comprises 80 percent of the park. The NPS anticipates that there will be more uses, special events, and access needs at MMNHP facilities in future years that may exceed existing capacity. The NPS will be evaluating pedestrian crossing needs on Route 2A to connect existing town paths and pedestrian patterns with the MMNHP trail system in the safest possible locations.

Several projects being planned in the park have been completed since the *2005 ESPR*: the rehabilitation of the Jacob Whitmore House and Barn as an educational center, continuing efforts to restore historic fields and vistas, and restoration of the stream feeding Elm Brook near the Noah Brooks Tavern. Restoration of the cultural landscape at the Wayside Tavern is nearly complete.

10.13.1 Soundscape Goals for the Minute Man National Historical Park

At the time of the *2000 ESPR*, the NPS headquarters was initiating preparation of a generic model document that would provide a nationwide approach to identifying desired noise criteria in national parks. Park Managers would use the guidance in developing their own Soundscape Management Plans, each tailored to the unique activities, land uses and environmental needs of their individual parks. A Draft Manual for Conducting Acoustics and Soundscape Studies in National Parks was released in August 2005. In addition, nationally, the NPS explored the issue of aircraft overflights in the 1994 Report on Effects of Aircraft Overflights on the National Park System, which recommended the continuation of the federal interagency working group that is described in the next section. The NPS issued Director's Order 47 (DO47) "Soundscape Preservation and Noise Management" in December 2000.

The NPS has completed an internal draft soundscape plan for MMNHP in 2010, including noise monitoring with professional and volunteer staff. Sound monitoring was conducted in 2008-09 at MMNHP by the NPS Natural Sounds Division and is included in the internal draft plan. The scope for the soundscape plan at MMNHP incorporates aspects of approaches that have been used at other NPS properties.

10.13.2 Interagency Working Group

The federal Interagency Working Group was established by the U.S. Department of Transportation, the U.S. Department of the Interior and the Advisory Council on Historic Preservation. A local Regional Working Group includes participation by the FAA, Federal Highway Administration and the National Park Service. Massport is not a member of the group. The Volpe Transportation Systems Center facilitates meetings of the Regional Working Group. The group meets locally on an as needed basis to maintain relationships among the member federal agencies. The NPS has indicated that the group is ongoing.

10.13.3 Current Status and Future Concerns

At the May 2013 coordination meeting between Massport and the NPS, the MMNHP Superintendent indicated ongoing concerns regarding how noise from aircraft affects park programming. Massport and the NPS discussed the Fly Friendly program instituted since the *2005 ESPR* with a noise abatement program and voluntary measures.

The NPS noted the trend at Hanscom Field for continued business air travel in leased or company owned jet aircraft. Business jets are general aviation traffic and part of Hanscom Field's role as a reliever for

Logan Airport. Noise from these and other aircraft taking off and landing, especially to the west and southwest from Hanscom Field, affects the North Bridge Unit, which lies nearly in line with Hanscom Field's east-west runway (Runway 11-29). Aircraft leaving or approaching Hanscom Field in this area can affect the intended park experience. Single engine piston aircraft operations, representing proportionately more take-offs and landings, have less effect because these aircraft generally make less noise over this area.

The analysis of noise exposure levels created by aircraft flying over the MMNHP includes: 65 and 55 dB DNL contours; Time Above 65 dBA and Time Above 55 dBA contours; and DNL, TA65, and TA55 calculations at 30 noise analysis locations in the park. The FAA considers 65 dBA as the onset of significant impact. In 2012, none of the noise analysis locations exceeded 55 dB DNL.

The NPS is also concerned about safety and safe access for employees and visitors along Route 2A. Their goal of protecting and restoring Battle Road includes confining adjacent Route 2A traffic to two lanes and establishing an appropriate visual environment for the visitor that is compatible with the ambiance of the park. Reducing congestion is important to the NPS as well. Among the concerns identified in their GMP regarding Route 2A traffic is the potential for traffic in excess of what the road is designed to handle. Redistributing parking facilities within the park has been effective, as have measures to keep the Battle Road portion of Route 2A at two lanes except at major intersections.

Studies conducted for the NPS considered the appropriate level of traffic volumes on Route 2A that would be acceptable from the perspective of a visitor's experience at the MMNHP⁷⁷ and alternative transportation options.⁷⁸ These studies reviewed approaches that would have a beneficial effect on the visitor experience by encouraging access rather than mobility. More recently, MAPC has coordinated the formation of a working group to develop a corridor management plan and possible designation of Route 2A as a Scenic Byway. The NPS also updated information on the status of individual buildings and landscapes within the park, including the addition of the Barrett Farm Unit. Other projects completed since 2005 include rehabilitation of the North Bridge and surrounding landscape, rehabilitation of the Jacob Whitmore House and installation of interactive educational exhibits, restoration of the John Nelson House and Barn, installation of new exhibits and video program in the North Bridge Visitor Center, rehabilitation of the historic Buttrick Gardens overlooking the North Bridge, restoration of 58 acres of historic fields and vistas in the Battle Road unit, and "daylighting" restoration of the formerly buried stream at Sunnyside Lane that feeds Elm Brook.

10.13.4 Environmental Effects in Minute Man National Historical Park

The noise analysis for the 2012 *ESPR* has been refined since the 2005 *ESPR*. Thirty-one locations within MMNHP were evaluated as noise analysis locations. The analysis of 2012 conditions indicates that noise exposure levels created by aircraft flying over MMNHP ranged from 45 dB to 52 dB. The highest level (51.4 dB) occurred at the Noah Brooks Tavern (and Carriage House) (MM-13). No areas of the MMNHP were within the 65 dB DNL contour in 2005 or 2012. No areas of the MMNHP were within the 55 dB DNL contour in 2012 as compared to 1.7 acres in 2005. TA65 values ranged from one to nine minutes at the thirty noise analysis locations, with the highest levels occurring at The Wayside-Samuel Whitney

⁷⁷John A. Volpe National Transportation Systems Center, Minute Man National Park: Rte 2A Traffic Analysis and Its Impact on the Park's Visitor Experience, June 2002

⁷⁸John A. Volpe National Transportation Systems Center, Minute Man Alternative Transportation Evaluation, April 2005

House (MM-7) and the Meriam House (MM-9). TA55 values ranged from 18 to 71 minutes, with the highest levels occurring at the Historic Farming Fields (MM-10) in the Bedford Levels.

In 2012, Hanscom Field traffic represented approximately four percent of the peak hour traffic on Route 2A. Only at one of the six traffic study intersections in the MMNHP (Hanscom Drive/Route 2A) did traffic associated with Hanscom Field represent more than ten percent of traffic movements.

As described in Chapter 8, Air Quality, all air pollutant concentrations are safely in compliance with health-based air quality standards. Therefore, this analysis concluded that no adverse air quality effects to historic resources including MMNHP are anticipated now or in future analysis years from activities at Hanscom Field.

10.13.5 Battle Road (Interpretative) Trail

The Battle Road Trail is an interpretive, multi-use trail that provides cycling, walking, and wheelchair access to the MMNHP's historical and natural resource areas. The route of the Battle Road Trail is shown on Figure 10-4. The stone-dust trail extends five and one-half miles from Fiske Hill in Lexington, through Lincoln, to Meriam's Corner in Concord. The trail contains 25-foot wide portions of the historic Battle Road from April 19, 1775 that are restored and linked together by seven-foot wide sections of trail that traverse landscapes that evoke the past. Other portions of the historic Battle Road Trail follow the route of today's Route 2A.

The DNL, TA65 and TA55 values at noise analysis locations along the Battle Road Trail were plotted in Figures 10-6 through 10-8. None of the five and one-half mile trail was within the 65 dB DNL contour in 2000 or 2005. None of the trail was within the 55 dB DNL contour in 2005 as compared to 0.1 miles in 2000. Figures 10-6 through 10-8 indicate that DNL and Time Above values are highest to the west of the Hartwell Tavern, reflecting the proximity of this area to runways at Hanscom Field. It should be noted that a visitor to the Battle Road portion of the park is also affected by the background noise of road traffic from Route 128/I-95 and Route 2A throughout most of the day, and that Hanscom Field-related vehicular traffic contributes approximately four percent to the traffic volumes on Route 2A.

As presented in Chapter 4, Airport Planning, Hanscom field is not visible from the Battle Road Trail with a few exceptions where the Air Traffic Control Tower may be seen. Figure 4-1 through 4-4 provide a visibility analysis at specific points along the trail in both a leaf-on and leaf-off condition.

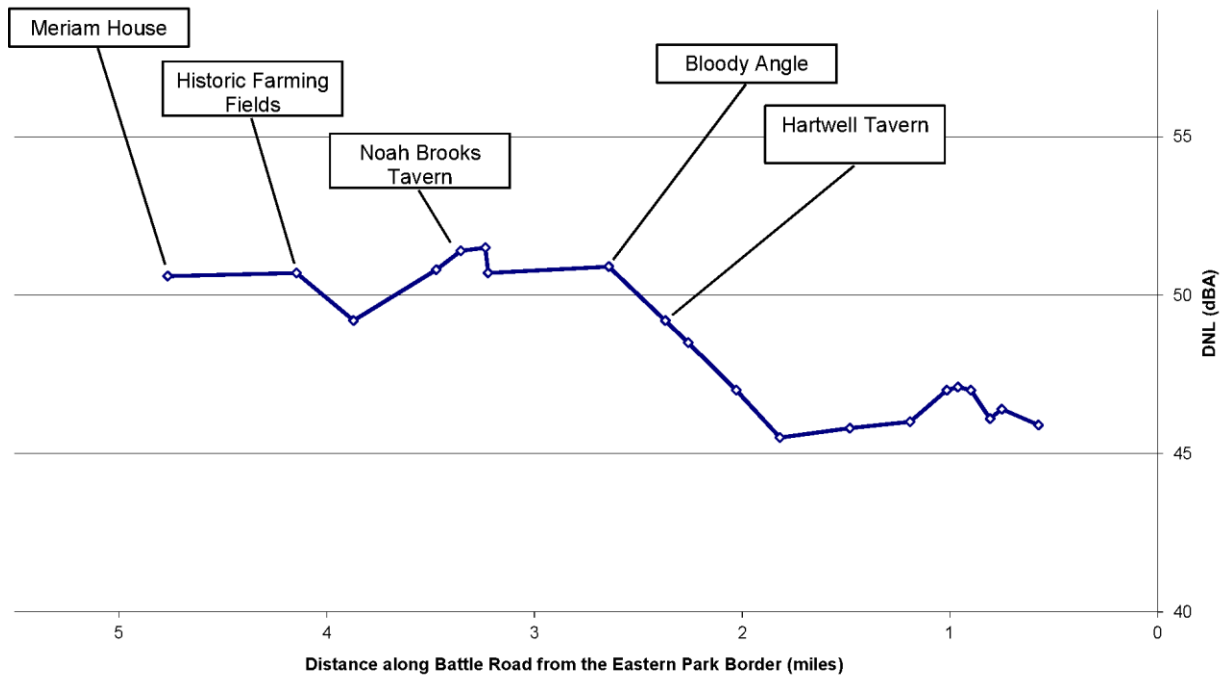


Figure 10-6 2012 DNL at Minute Man National Historic Park Battle Road Unit Location

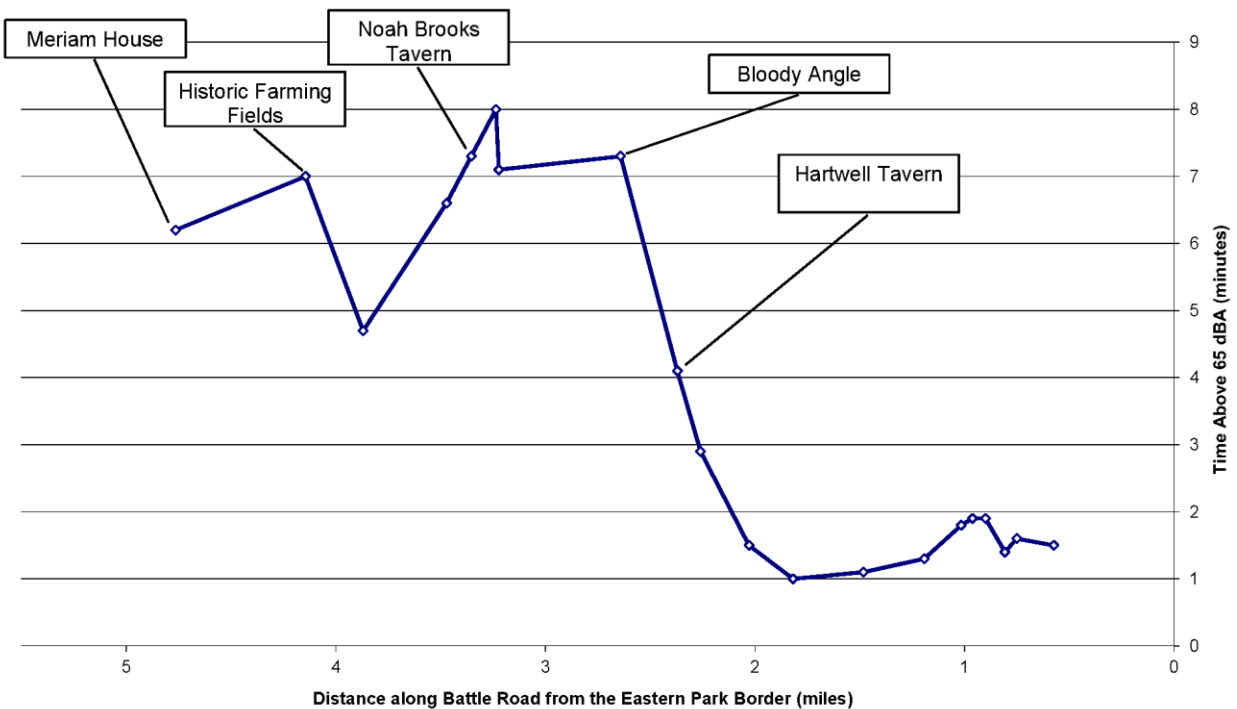


Figure 10-7 2012 Time Above 65 dBA at Minute Man National Historic Park Battle Road Unit Locations

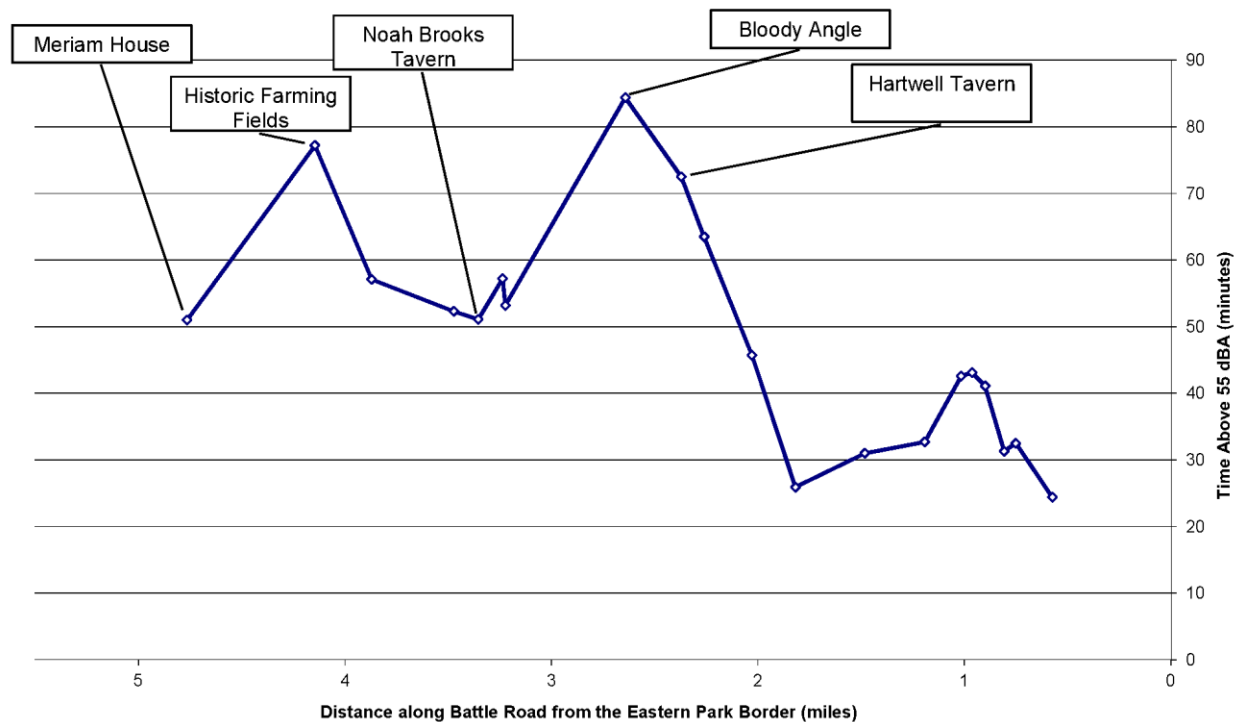


Figure 10-8 2012 Time Above 55 dBA at Minute Man National Historic Park Battle Road Unit Locations

10.14 Recreational and Conservation Lands

A review of the four towns' most recent Open Space and Recreation plans was undertaken to gain an understanding of the goals and objectives of the plans and any recommendations for acquiring additional lands and expanding recreational opportunities. Changes in recreational and conservation land since the 2005 *ESPR* were identified through discussions with Town Planners and review of MassGIS database. Specific information on the Great Meadows National Wildlife Refuge is presented below, following the sections about the four towns. Recreational and conservation lands, and the Great Meadows National Wildlife Refuge, are shown in Figure 10-9. Additional information about the plans of the four towns is presented in Chapter 4, Airport Planning.

10.14.1 Bedford

The Town of Bedford, which abuts Hanscom Field along its northern boundary, includes 1,870 acres of public and private conservation lands, which represent 21 percent of the town's total land area. 870 acres are owned and managed by the Town through its Conservation Commission with assistance from a volunteer group of residents referred to as the Bedford Land Stewards, 672 acres are part of Great Meadows Wildlife Management Area, and the remainder comprises privately owned conservation lands.

The town's open space plan was most recently updated in 2004. The document emphasizes the importance of providing good linkages between historic, recreation and conservation resources throughout the town, and identifies athletic fields as a resource in need of greater consideration. It also includes a population analysis for recreational land use. The Open Space Goals identified in 2004 are listed below:

Goal 1: Preserve the small town New England character of Bedford.

Goal 2: Protect valuable water resources, aquifer recharge areas and unique wildlife habitat areas.

Goal 3: Enhance the potential of the Town's existing open space and conservation resources.

Goal 4: Preserve and protect historic and cultural properties and sites.

Goal 5: Preserve large tracts of undeveloped lands.

Goal 6: Develop and improve a network of trails, sidewalks and bikepaths between neighborhoods, public facilities, conservation and recreation lands and commercial areas.

Goal 7: Enhance the quality and variety of recreational opportunities, both passive and active, for all age groups and abilities in the Town of Bedford.

Three sites that currently abut Hanscom Field to the north include the Elm Brook Conservation Area, Hartwell Forest and the Jordan Conservation Area. The Town of Bedford purchased the Elm Brook Conservation Area (19 acres) in 1978 to protect valuable wetland resources, establish nature trails and provide a vegetative buffer for area neighborhoods. This site offers a potential trail link between the Minute Man Bikeway, which terminates in Bedford, and the existing east-west railroad bed.

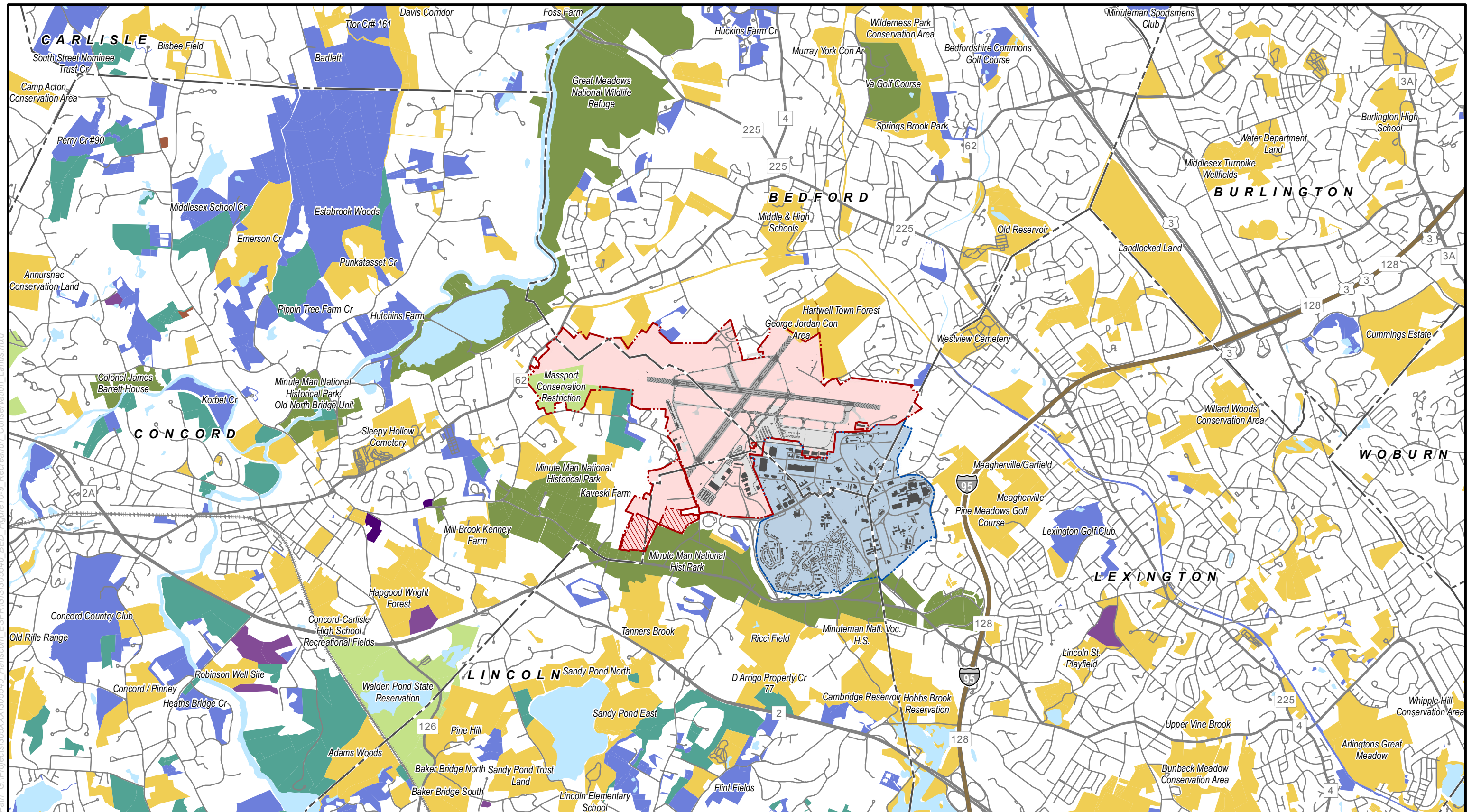
The Hartwell Town Forest is Bedford's largest conservation area with over 118 acres of mature forest, open fields and wetland resources. Hartwell Town Forest is located between the Hartwell Road residential neighborhood and Hanscom Field's northern boundary. This was the first piece of town property to be dedicated for conservation purposes back in 1940. Key natural features include Hartwell Brook, wetlands, mature white pine forest, and open fields. In addition to its natural attributes, Hartwell is used for hiking and cross-country skiing along its extensive trail system. The forest, which includes two camping and picnic areas, is used for overnight camping by scout troops.

The Jordan Conservation Area (37 acres) is located adjacent to and west of Hartwell Town Forest. This site provides outdoor recreational opportunities including a nature trail system for local residents. The trail system extends through the Jordan Conservation Area from the Hartwell Forest and connects to the Air Force family campground on the north side of Hanscom Field. This site also includes several areas of diverse wildlife habitat. Approximately 0.1 acres of the Hartwell Town Forest/Jordan Conservation Area fell within the 65 dBA DNL contour in 2012 as compared to 4.8 in 2005.

Massport's Vegetation Management Plan (VMP) described vegetation obstructions including areas of the Hartwell Town Forest/Jordan Conservation Area. In the context of the VMP, Massport determined the extent of tree cutting required to remove obstructions in accordance with the FAA's airspace safety standards. In 2010, delineated wetlands in the area where work was required. In strict compliance with conditions issued by the Town's Conservation Commission, Massport hired an experienced forestry company to remove the obstructions with minimal impact on wetland resources. As part of the mitigation, Massport created new recreational trails across the northern part of Massport property to improve trail connections between Bedford and Concord Conservation Lands.

Other properties located near Hanscom include the Mary Putnam Webber Wildlife Preserve, the Vanderhoof Conservation Area, and the Dellovo Conservation area. These parcels abut the western edge of Hanscom Field and the Narrow-Gauge Rail-Trail in Bedford. The Open Space Plan notes that additional land acquisitions are planned in this area to provide for conservation land buffers along the Hanscom Field boundary.

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|--|--|--|--------------------|--|---------------------------|
| | Hanscom Field Property Boundary | | Federal | | Land Trust |
| | Massport Property within MNHP Congressional Boundary | | State | | Conservation Organization |
| | Hanscom AFB Property Boundary | | Municipal | | Interstate |
| | Municipal Boundary | | Private for Profit | | Highway |
| | | | Public Non-Profit | | Road |
| | | | Non-Profit | | Active Rail Service |
| | | | Open Water | | |



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Recreational and Conservation Lands

Data Sources: MassGIS (Roads, Rail), March 5, 2013; MassGIS (Bike Trails, Tracks and Trails), March 7, 2013; MassGIS (Community Boundaries), March 5, 2013; MassGIS (Areas of Environmental Critical Concern, Protected and Recreational Open Space, Scenic Landscape Inventory), March 7, 2013;

Figure 10-9

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10.14.2 Concord

In 2004, the Town of Concord completed the Open Spaces and Recreation Plan.⁷⁹ The plan preceded the completion of the much larger Comprehensive Long Range Plan: A Vision for 2020.⁸⁰ The town established a committee to update the Open Space Plan which has convened meetings in 2013. The focus of both documents is on the continued preservation of Concord's historic and scenic character. The Open Spaces and Recreation Plan identifies 15 primary planning goals:

1. Incorporate the Open Spaces and Recreation Plan in Town and community decision-making.
2. Think regionally and work collaboratively with towns in Concord's region.
3. Protect Concord's large natural areas.
4. Protect Concord's large agricultural areas and farming.
5. Protect major wildlife and water-protection corridors.
6. Strengthen neighborhoods in Town.
7. Manage water-related issues to protect the Town's groundwater and surface water.
8. Protect and monitor Concord's streams, rivers, ponds and wetlands.
9. Monitor wildlife and biodiversity and protect key habitats.
10. Reduce the major impacts of Route 2.
11. Meet intensive-use recreational needs consistent with Concord's open space frame work.
12. Solidify the local/regional trail network for transportation and nature-based recreation.
13. Provide handicap access to open space resources.
14. Manage all land in Town consistent with open space objectives.
15. Secure funding and partner with other entities for open-space land protection.

According to the Open Space Plan, there is 5,803 acres of protected open space in Concord, which represented 37 percent of the town's total land area. The town manages 1,320 acres of that land and the private non-profit Concord Land Conservation Trust owns 850 acres. The Open Spaces and Recreation Plan identifies seven large natural areas that are particularly important open space resources for the Town of Concord. In addition, the Town of Concord and Massport agreed in 1990 to place a conservation restriction on a Massport-owned parcel of land that is approximately 50 acres in size near the west end of the airfield. In 1996, the Town of Concord obtained additional parcels of land as part of the Concord Farms Limited partnership. These parcels abut Massport's southern property line.

Estabrook Woods Area is the largest natural area in Concord consisting of 1,475 acres. Nine hundred of those acres, most of which are owned by Harvard University for educational and research purposes, have been set aside since 1992. The Estabrook Woods Area also includes Middlesex school land, Bateman's pond, Punkatasset town conservation land, and areas north to Carlisle. Estabrook Woods is a significant

⁷⁹Natural Resources Commission, Town of Concord, Open Space and Recreation Plan 2004, Concord, Massachusetts, October 2004.

⁸⁰Comprehensive Long Range Plan Committee, Town of Concord, Comprehensive Long Range Plan: A Vision for 2020, Concord, Massachusetts, March 2005.

open space resource for wildlife, geological and archeological sites, hiking, cross country skiing and horseback riding. As well, the Massachusetts Division of Fish and Game has identified the Estabrook Woods as a “significant wildlife area due to habitat diversity and area size.” Preserving its unique natural character is a special priority for the Town of Concord.

The Great Meadows/Ball’s Hill area includes Great Meadows National Wildlife Refuge and continuous vegetation to the north and west of the Concord River. It consists of 738 acres of land in Concord. This natural area around the “wild and scenic” Concord River is a resource for wildlife, particularly migratory birds. The scenic beauty found at this natural area makes it a desirable place for hiking, canoeing and photography.

Walden Woods/Town Forest area is made up of approximately 1,180 acres and includes Fairyland Pond, the Town Forest, Brister’s Hill, Walden Pond State Reservation (202 acres) and Fairhaven Hill. The setting for Henry David Thoreau’s Walden, the area is a National Historic Landmark and on the National Register of Historic Places. Walden Woods allows for a great diversity of recreational activities including swimming, year round fishing, and hiking. The Open Spaces and Recreation Plan identifies four major threats to Walden Woods: 1) The use of the former landfill area; 2) housing developments; 3) heavy recreation use; and 4) the effects of Route 2 and Route 126.

Virginia Road Woods is located primarily on Massport property and is made up of Bedford Levels, Elm Brook, Pine Hill, and areas north to the Bedford line. The area is managed as an airport buffer and therefore occasionally experiences vegetation management by Massport. The Town of Concord wishes to continue to work with Massport to ensure the area continues to function as a “large natural area” for species benefiting from the lack of public access.

Annursnac Hill/Strawberry Hill Road natural area consists of the Annursnac Town Conservation Land to the south and the woodland north of Strawberry Hill Road (118 acres). In the long term, the Town of Concord is interested in further evaluation of better wildlife connectivity between the two sections.

Of the conservation areas in Concord that are described, only Great Meadows is subject to the 55 DNL noise contour. In 2012, the 55 DNL occupied 26.4 acres of Great Meadows which was a decrease from 197.6 acres in 2005. The Jennie Dugan Kames area includes the brook, golf course and woods within Concord Country Club, and extends eastward across the Sudbury River towards the Concord Land Conservation Trust’s Soutter Land. It is the only large natural area located in the center of town and serves as a valuable bridge between various other conversation areas. The Jennie Dugan Kames area contains many wetland resources, including a large vernal pool, and habitat and species diversity is high.

10.14.3 Lexington

The Town of Lexington has an estimated 2,842 acres of public and privately owned open space, which represents approximately 27 percent of the town's total land area. The town owns and manages 1,840 acres of that land for passive and active recreation purposes. Several conservation and recreation areas are located near Hanscom Field.

Lexington produced an updated Open Space Plan in 2009. The goals of the plan are:

1. Establish and implement a land management program that will assure optimal maintenance and use of conservation lands.
2. Protect Lexington’s natural environment, both within and beyond the borders of open space and recreational properties.

3. Promote public use of recreational facilities and open space among a wide variety of user types.
4. Provide a balance of recreational activities for all of Lexington's citizens.
5. Preserve and enhance the scenic and historical value of Lexington.
6. Enhance connectivity between open space and recreation areas.
7. Acquire parcels that are important from an environmental, recreational, or historical perspective.
8. Protect and maintain Lexington's brooks.
9. Preserve, protect, and improve Lexington's recreational infrastructure.

When considering the acquisition of additional parcels in the community, the Conservation Commission has placed a strong emphasis on the establishment of wildlife corridors. Tophet Swamp and Kiln Brook, totaling 60 acres, are located between Hartwell Avenue and Route 128/I-95. These conservation areas are considered significant ecological areas and serve as wildlife corridors.

From a recreation standpoint, the Town of Lexington has two areas near Hanscom Field: the Pine Meadows Country Club (90 acres) and Katahdin Woods. The Pine Meadows Golf Course, situated near Route 95 and approximately one mile southeast of Hanscom Field, was purchased by the Town of Lexington in 1990 and is the largest recreational land holding owned by the town. Katahdin Woods, located adjacent to Kiln Brook, is a 38-acre conservation area that offers passive recreation in the form of hiking and nature viewing.

The central portion of the Minute Man Commuter Bikeway is located in Lexington. It provides access to many recreational areas, including the Adams School playground. The town would like to promote additional linkages to this highly acclaimed bikeway to provide additional recreational opportunities for its residents. No areas conservation areas in Lexington will be subject to the 55 DNL noise contour.

10.14.4 Lincoln

The Town of Lincoln has preserved 2,859 acres of land, representing approximately 31 percent of the town's total land area. When including state and federal land associated with Walden Pond, Great Meadows, and MMNHP, the amount of protected land is 3,282 acres or 35% of land in town. The two conservation properties that are near Hanscom Field are the Tanners Brook and Ricci properties. Tanners Brook, located south of Hanscom Field across Route 2A, is a 110-acre tract of land consisting of woodlands, wetlands and the headwater of Elm Brook. This parcel contains a series of winding hiking trails that are available to the public. The Ricci property consists of 94 acres of agricultural fields, woods and wetlands. Hobbs Brook runs through the southern portion of the property.

The Lincoln Conservation Commission has had responsibility for acquiring and managing environmentally sensitive lands throughout the community since 1958. The Commission currently has several additional large parcels under review for purchase as well as a few smaller properties that would provide trail linkages.

In addition to the Commission's efforts, the Lincoln Land Conservation Trust was formed in 1957 for the purpose of maintaining open space in the community through holding certain lands in trust. Over time, the Lincoln Land Conservation Trust has contributed to the protection of over 1,000 acres of land in Lincoln. The Trust currently protects and maintains approximately 375 acres of land and over 60 miles of trails located on existing conservation lands and traversing private properties. Lincoln is the first town in the Commonwealth to establish a land conservation trust.

In January 2010, the Lincoln Conservation Commission established a seven-year action plan. The plan establishes the following goals:

1. Preserve Lincoln's agricultural, recreational and natural resource values
2. Promote active stewardship of existing agriculture and conservation land
3. Maximize recreational opportunities on recreational and conservation land
4. Foster a sense of coordination, education and outreach regionally and locally

Each goal includes action items and responsible parties for achieving the goal.

10.14.5 Great Meadows National Wildlife Refuge

The Great Meadows National Wildlife Refuge is located approximately 20 miles west of Boston within the corporate boundaries of Concord, Sudbury, Billerica, Bedford, Carlisle, Lincoln, and Framingham (see Figure 10-9). The Great Meadows National Wildlife Refuge is situated due west of Hanscom Field, approximately 1.5 miles from the approach end of Runway 11. The Great Meadows Wildlife Refuge was established in 1944 as a migratory bird sanctuary with additional purposes of natural resource protection, fish and wildlife recreational development and protection of rare and endangered species.

The Great Meadows National Wildlife Refuge consists of 3,863 acres of freshwater wetland resources and wildlife habitat along the Concord and Sudbury Rivers from the Route 4 Bridge in Billerica to the Framingham/Wayland Line. The Concord River emanates at the confluence of the Sudbury and Assabet Rivers located in the Town of Concord. It flows to the north where it eventually merges with the Merrimack River in Lowell. According to the USFWS, the Refuge preserves historic landscapes used by Native Americans and early settlers and inspired the thoughts of writers and environmental philosophers including Henry David Thoreau and Ralph Waldo Emerson.

According to the U.S. Fish and Wildlife Service, over 500,000 people visit the area on an annual basis. Numerous outdoor educational programs are available at the refuge site for school children and the public at large. In 2005, the U.S. Fish and Wildlife Service prepared a Comprehensive Conservation Plan for the Great Meadows National Wildlife Refuge.⁸¹ The plan developed five goals to support the mission of the Refuge System and Gulf of Maine Ecosystem Priorities:

1. Protect and enhance habitats that support self-sustaining populations of federal trust species and wildlife diversity
2. Recover threatened and endangered species of the complex
3. Build a public that understands, appreciates and supports refuge goals for wildlife
4. Adequately protect cultural resources that occur in the complex
5. Maintain a well-trained, diverse staff working productively toward a shared refuge vision

Riverine habitat (i.e., habitat associated with the river) and floodplains comprise approximately 80 percent of the refuge land with eight percent consisting of forested wetlands. The remaining 20 percent can be characterized as upland resources, including forested areas and open fields. Most of this land was formerly in agriculture that has since converted to overgrown fields and white pine forests.

The Great Meadows National Wildlife Refuge is divided into two divisions, including the Concord Division (1,542 acres), which is land drained by the Concord River, and the Sudbury Division (2,321

⁸¹U.S. Fish and Wildlife Service, Great Meadows National Wildlife Refuge Final Comprehensive Conservation Plan, January 2005

acres), which is land drained by the Sudbury River, and associated tributaries as established by the U.S. Fish and Wildlife Service. Several pond impoundments are located along the river corridor in Concord, as well as the Strand and Headquarters Ponds in Sudbury.

Over 220 species of reptiles, amphibians and mammals have been documented within the Great Meadows National Wildlife Refuge corridor. Many species of migratory birds use the refuge as a stopover during the fall and spring migration periods, including peregrine falcons and bald eagles. No federally protected endangered or threatened species are known to reside in the Great Meadows National Wildlife Refuge on a permanent basis.

None of the Great Meadows National Wildlife Refuge was within the 65 dB DNL contour in 2005 or 2012. Approximately 26 acres of Refuge land are located within the 55 dB DNL contour in 2012 as compared to 197 acres in 2005.

10.14.6 Concord River

Chapter 9, Wetlands Wildlife and Water Resources discusses the Concord River, which is a designated Wild and Scenic River. The Concord River, located northwest of Hanscom Field, is a component of the Sudbury-Assabet-Concord (SuAsCo) Wild and Scenic River System, and flows roughly southwest to northeast. As illustrated in Figure 10-9, the segment of the Concord River nearest to Hanscom Field is approximately one-half mile northwest from Hanscom Field, and slightly more than one mile from the nearest Hanscom Field runway (11-29). None of the Concord River was within the 65 dB DNL contour in 2005 or 2012. No segment of the Concord River is in the 2012 55 dB DNL contour as compared to 0.5 miles in 2005.

10.14.7 Minuteman Commuter Bikeway

The Minuteman Commuter Bikeway is a ten-mile paved bikeway that connects Bedford at the Bedford Depot Park with Lexington, Arlington and Cambridge, terminating at the MBTA Alewife Red Line station where connections can be made to the Red Line Linear Bikepath through Cambridge and Somerville. The bikeway was constructed by the Massachusetts Highway Department and is maintained by the four towns of Arlington, Bedford, Cambridge and Lexington. The bikeway opened in 1993 and was extended from East Lexington to Alewife Station in 1998. The bikeway is twelve-feet wide and is open year-round from 5:00 a.m. to 9:00 p.m.

None of the ten mile Minuteman Commuter Bikeway was within the 65 dB DNL contour in 2005 or 2012. Approximately 1.3 miles of the Minuteman Commuter Bikeway was within the 55 dB DNL contour in 2005 and that decreased to 0.3 miles in 2012. It should be noted that users in some sections of the Minuteman Commuter bikeway are affected by the background noise of road traffic from Route 128/I-95 and other roadways that cross or parallel the bikeway. Hanscom Field-related traffic contributes only a small percentage to this traffic.

10.14.8 Narrow Gauge Rail-Trail

The Narrow-Gauge Rail-Trail is a three-mile trail that runs from a point near the Bedford Depot at Loomis Street to the Billerica town line. The trail is paved asphalt between Loomis Street and the Great Road and is a stone-dust trail in the other section. The entire Narrow-Gauge Rail-Trail is located outside the 65 dB DNL and the 55 dB DNL contour.

10.14.9 Agricultural Resources

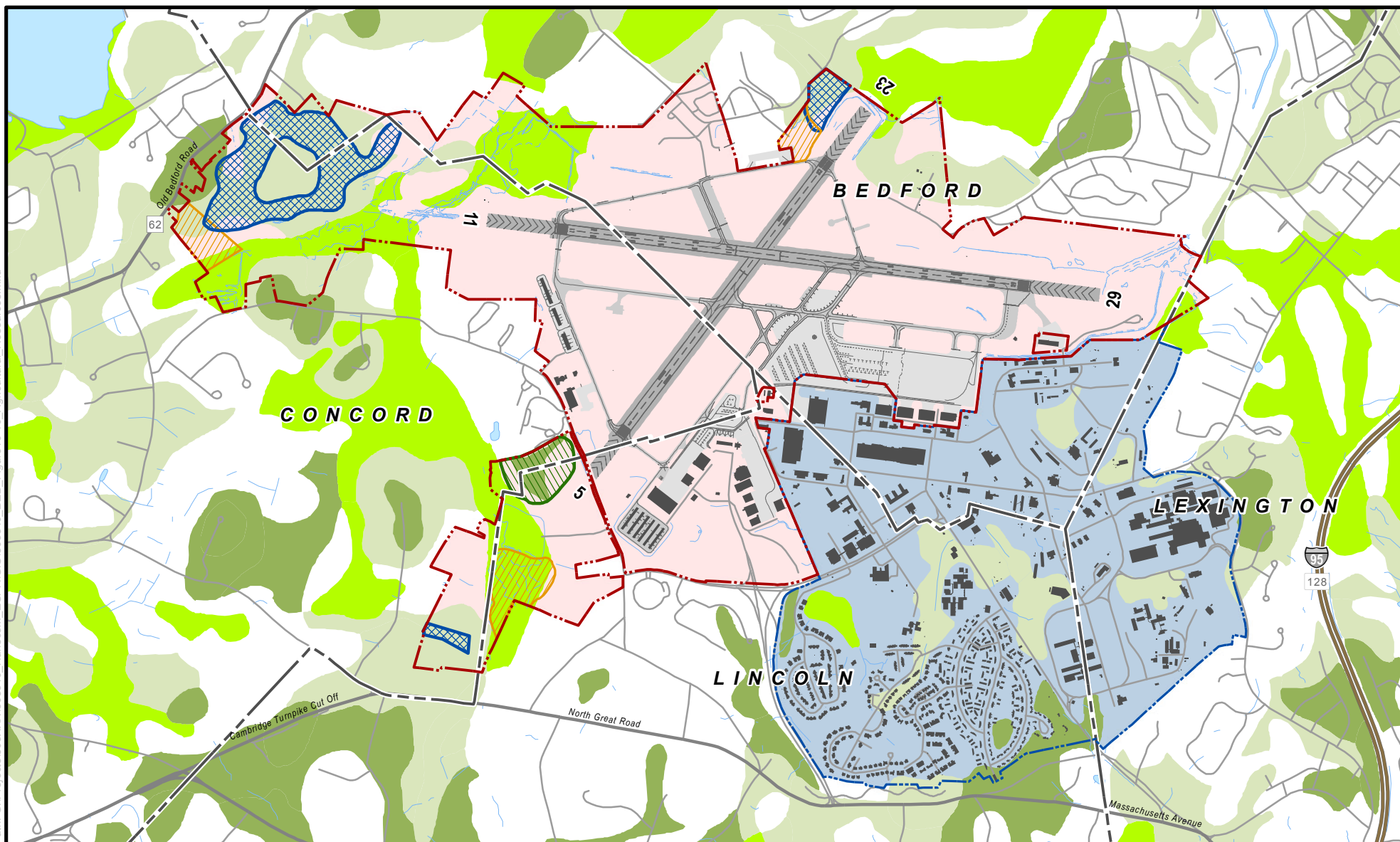
The location of agricultural resources is shown in Figure 10-10. Hanscom Field contains soils identified on mapping prepared by the U.S. Natural Resources Conservation Service as having varying levels of agricultural potential.⁸² Such soils are described as either Prime Farmland soils or Farmland Soils of Local/State Importance, defined as follows:

1. Prime Farmland – land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber and oilseed crops, and is also available for these uses.
2. Locally Important Farmland – farmland that fails to meet the requirements of prime farmland, but is of statewide importance for the production of food, feed, fiber or forage crops.

Figure 10-10 shows Areas of Prime Farmland and Farmland Soils of Local Importance at Hanscom Field. Limited agricultural activity currently occurs at Hanscom Field. Mowing of runway infield areas is performed to maintain low grassland vegetation for safe sight distances for aircraft operation and to provide grassland habitat for protected avian species. Agricultural operations within an airport setting must be restricted for reasons of safety for both aircraft operations and for farm workers located in proximity to operating aircraft. There is agricultural activity in outlying areas.

⁸²Middlesex County, Massachusetts Interim Soil Survey Report - July 1995, and draft maps

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- Hanscom Field Property Boundary
- Hanscom AFB Property Boundary
- Municipal Boundary

Agricultural Resources (Massport)

- Locally Important Farm Soils
- Open and Mowed Areas
- Prime Farmland Soils

- Interstate
- Highway
- Road

NRCS SSURGO Soils Data

- Prime Farmland Areas
- Farmland of Statewide Importance
- Farmland of Unique Importance

- Open Water
- Stream



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Agricultural Resources

Data Sources: MassGIS (Roads, Rail), March 5, 2013; MassGIS (Bike Trails, Tracks and Trails), March 7, 2013; MassGIS (Community Boundaries), March 5, 2013; MassGIS (Soils), Oct 22, 2013;

Figure 10-10

Prior to the 2005 *ESPR*, Massport met with Massachusetts Department of Agricultural Resources (MADAR) representatives to discuss envisioned uses of known agricultural soils at Hanscom Field. There have been no changes to use and management of agricultural lands at Hanscom since the filing of the 2005 *ESPR* with one exception. In 2009, Massport has made available 1.8 acres of land in Concord to Gaining Ground, a non-profit organic farming organization, for agricultural use. Massport continues to work with MADAR to determine appropriate measures to protect Massport-owned agricultural lands from conversion to non-agricultural uses. Massport will inform the towns about actions related to agricultural lands as part of its briefings at HFAC meetings.

10.15 Analysis of Future Scenarios

This section analyzes the potential effects of the 2020 and 2030 scenarios on historical, cultural, recreational, and conservation resources within and in the vicinity of Hanscom Field. The environmental analysis focuses on traffic and noise effects of the 2020 and 2030 scenarios. The air quality assessment, discussed in Chapter 8, Air Quality concludes that even maximum air concentrations for the 2020 and 2030 scenarios comply with all health-based air quality standards and therefore will result in no adverse air quality effects to historic resources including MMNHP.

The analyses of historical and cultural resources use information on future aviation operations activity levels presented in Chapter 3, Airport Activity Levels, and potential new facilities described in Chapter 4, Airport Planning. Data is also derived from the evaluation of traffic volumes and intersection operations that are described in Chapter 6, Ground Transportation; and noise analyses for DNL and TA measurements that are presented in Chapter 7, Noise.

Any future project at Hanscom Field will undergo a project-specific environmental review process in the event that MEPA or other applicable environmental review thresholds are met. The historic resources and archaeological reconnaissance surveys, which are included in Appendix G, will provide baseline data for these assessments. Additional cultural and historical properties may be identified through more detailed intensive-level surveys in that process and will be addressed at that time. The potential effects on specific recreational and conservation resources would also be evaluated at that time.

As described in Chapter 6, Ground Transportation, the 2012 *ESPR* reflects Massport's commitment to TDM and traffic management approaches to address future Hanscom Field-related traffic volumes, rather than physical modifications to intersections to add capacity. The traffic analysis focuses on predicted traffic volume changes on Route 2A in the MMNHP.

As stated in Chapter 7, Noise, any significant changes in noise exposure are assessed based on both the absolute value of the projected DNL, as well as the magnitude of the change. Noise analysis considers as significant changes in DNL on the order of 1.5 dB or more for areas within the 65 dB DNL noise contour and changes of 3.0 or more decibels between 60 and 65 dB DNL⁸³ Noise impact criteria are used to determine areas for further analysis and possible mitigation when completing environmental documentation for a specific project at an airport. Though the 2012 *ESPR* is not an environmental permitting document for a project, the use of these criteria help to highlight notable changes in the noise environment at Hanscom Field.

⁸³U.S. Department of Transportation, Federal Aviation Administration, Office of Environment and Energy, Environmental Impacts: Policies and Procedures, FAA Order 1050.1E CHG1, Washington, DC.

Chapter 7, Noise, presents 2020 and 2030 noise exposure levels at noise analysis locations including those that are cultural and historic resources. The 65 dB DNL noise contour was used as a guideline for determining potential land use incompatibilities, in accordance with FAA guidelines. The Secretary directed Massport to evaluate the extent of the 55 dB DNL noise contour in the 2012 *ESPR*.

10.15.1 Historical Resources

This section assesses potential effects to historical resources that could result from the 2020 and 2030 scenarios. Assessment of future noise effects to historical resources primarily focuses on the National and State Registers-listed, MHC Inventory and MACRIS-listed resources. Information about the environmental effects to MMNHP is contained in a separate section below.

10.15.2 State Register Resources

Figure 10-11 illustrates the location of historic resources relative to the noise contours for the 2020 and 2030 growth scenarios. The figure includes the contours for 2005 and 2012 as well for comparing future noise with that experienced in recent years. Table 10-14 presents DNL values for the 2020 and 2030 scenarios at the ten locations with the highest DNL values in 2012. No historical resources fall within the 65 dB DNL noise contour or experience increased exposure of 3.0 dB or more at DNL levels between 60 and 65 dB. As compared to the 2005 DNL values, the increases in DNL values for most sites are less than one decibel and have DNL values below 55 dB in the 2020 and 2030 scenarios.

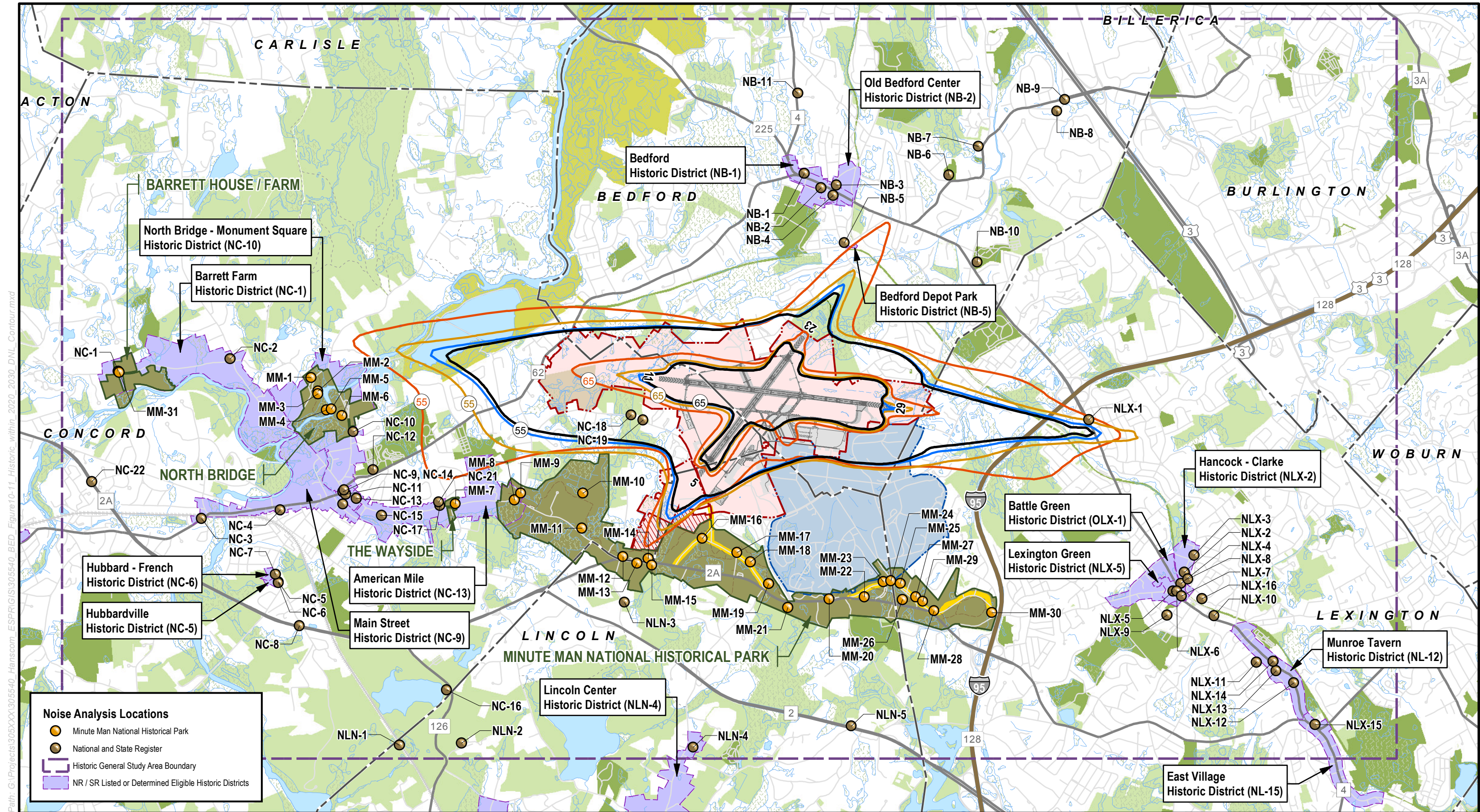
Table 10-14 DNL Values for Historic Architectural Resources Listed in the National and State Registers of Historic Places

MHC Number	Name ¹	Street Address	Town	Noise Label	2005	2012	2020	2030
CON.177	Deacon John Wheeler- Captain Jonas Minot Farmhouse (aka Thoreau Birthplace)	341 Virginia Rd.	Concord	NC-18	60.4	58.4	58.7	59.8
CON.178	Wheeler-Meriam House	477 Virginia Rd.	Concord	NC-19	59.9	58.1	58.4	59.4
LEX.413	Simonds Tavern	331 Bedford Street	Lexington	NLX-1	55.5	53	53.6	54.7
CON.170	Orchard House	399 Lexington Rd.	Concord	NC-17	53.8	50.2	50.4	51.6
BED.V	Bedford Depot Park Historic District	80 Loomis St. and 120 South Rd.	Bedford	NB-5	53.7	49.8	50.3	51.3
CON.317	Ralph Waldo Emerson House	28 Cambridge Turnpike	Concord	NC-15	52.9	49.1	49.3	50.5
CON.802 (CON.DY)	Sleepy Hollow Cemetery	24 Court Ln.	Concord	NC-12	52.2	49	49.2	50.4
CON.DS	American Mile Historic District	Lexington Road	Concord	NC-13	51.7	48.5	48.7	49.9
CON.329	Wright Tavern	Lexington Rd. & Main St.	Concord	NC-11	51.0	48.2	48.3	49.5
CON.A	Concord Monument Square-Lexington Road Historic District	Monument Sq. and Lexington Rd.	Concord	NC-14	50.9	48.1	48.2	49.4

Note:

1. The historic districts and properties with the ten highest DNL values in 2005/12 are listed in order of their 2012 DNL value. MMNHP sites are included in Table 10-17.

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Data Sources: ESRI (USGS Topographic Maps), March 4, 2013; MassGIS (Community Boundaries), March 5, 2013; PAL, Inc. (Noise Sensitive Receptors), August 28, 2013



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Historic Resources within the
2005, 2012, 2020 and 2030 DNL
Noise Contours

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10.15.3 2020 Scenario

Two historic properties in Concord that are located on Virginia Road next to Hanscom Field would have DNL values between 55 and 60 dB DNL in the 2020 scenarios:

1. The Deacon John Wheeler/Capt. Joseph Minot Farmhouse is forecast at 58.7 dBA in the 2020 scenario (compared to 58.4 dBA in 2012)
2. The Wheeler-Meriam House is forecast at 58.4 dBA in the 2020 scenario (compared to 58.1 dBA in 2012)

The next highest predicted level for a historical resource, Simonds Tavern in Lexington, would have a DNL value under 55 dB DNL, with a DNL value of 53.6 dBA in the 2020 scenario (compared to 53 dBA in 2012). All other sites would have a DNL value below 55 dBA in both the 2020 scenario.

The highest predicted TA65 level occurs at the Deacon John Wheeler/Capt. Joseph Minot Farmhouse for the 2020 scenario, which increases from 34.5 minutes a day in 2012 to 42.0 minutes a day in the 2020 scenario. The highest 2020 TA55 level occurs at Wheeler-Meriam House, which increases from 141.7 minutes a day in 2012 to 166.2 minutes a day in the 2020 scenario.

Each of the 17 historic districts listed in Table 10-15 is outside the 65 dBA DNL contour for the 2012, 2020, and 2030 scenarios.

Table 10-15 Area of National and State Registers Historic Districts within the 55 dBA DNL Contour

MHC Number	Name ¹	Acreage	2012	2020	2030
BEDFORD					
BED.V	Bedford Depot Park Historic District	6.8 acres	-	0 acres	0 acres
BED.A	Bedford Historic District	42 acres	0 acres	0 acres	0 acres
BED.C	Old Bedford Center Historic District	79 acres	0 acres	0 acres	0 acres
BED.K	Old Burlington Road- Wilson Mill Area	2.7 acres	0 acres	0 acres	0 acres
CONCORD					
CON.DS	American Mile Historic District	133 acres	0 acres	0 acres	0 acres
CON.DT	Barrett Farm Historic District	221 acres	0 acres	0 acres	0 acres
CON.A	Concord Monument Sq.- Lexington Rd Historic District	42 acres	0 acres	0 acres	0 acres
CON.EA	Hubbard-French Historic District	2.6 acres	0 acres	0 acres	0 acres
CON.DZ	Hubbardville Historic District	6.6 acres	0 acres	0 acres	0 acres
CON.DU	Main Street Historic District	74 acres	0 acres	0 acres	0 acres
CON.DV	North Bridge- Monument Square Historic District	89 acres	0 acres	0 acres	0 acres
LEXINGTON					
LEX.B	Battle Green Historic District	110 acres	0 acres	0 acres	0 acres
LEX.E	East Village Historic District	56 acres	0 acres	0 acres	0 acres
LEX.C	Hancock-Clarke Historic District	34 acres	0 acres	0 acres	0 acres
LEX.AC	Lexington Green Historic District	17 acres	0 acres	0 acres	0 acres
LEX.D	Munroe Tavern Historic District	70 acres	0 acres	0 acres	0 acres
LINCOLN					
LIN.A LIN.D	Lincoln Center Historic District	187 acres	0 acres	0 acres	0 acres
Note: 1. All districts are outside the 65 dBA DNL contours for 2012 and the 2020 and 2030 scenarios. MMNHP is discussed separately.					

10.15.4 2020 Scenarios

No historic sites would be exposed to DNL values greater than 65 dB in the 2030 scenario. Increases are projected to be between 0.5 dB and 1.5 dB. Two properties are expected to have noise levels between 55 and 65 dB; which represent a reduction in levels from 2005 conditions:

- Deacon John Wheeler/Capt. Jonas Minot Farmhouse (NC-18) in Concord forecast at 59.8 dBA in the 2030 scenario (compared to 58.4 dBA in 2012)
- Wheeler-Meriam House (NC-19) in Concord forecast at 59.4 dBA in the 2030 scenario (compared to 58.1 in 2012)

None of the other resources would experience noise levels that exceed 55 dBA.

The highest predicted TA65 level would occur at the Deacon John Wheeler/Capt. Joseph Minot Farmhouse in the 2030 scenario; the TA65 would increase from 34.5 minutes a day in 2012 to 60.1 minutes a day in 2030. The highest predicted TA55 level would occur at Wheeler-Meriam House in the 2030 scenario; the TA65 would increase from 141.7 minutes a day in 2012 to 223.8 minutes a day.

Table 10-16 Historic Resources in the MHC Inventory and MACRIS within the 65 dBA and 55 dBA DNL Contours for the 2020 and 2030 Scenarios

Location ¹	2012 MHC Inventory ²	2012 ³		2020 ³		2030 ³	
		65 dBA	55 dBA	65 dBA	55 dBA	65 dBA	55 dBA
AREAS							
Bedford	6	-	5	-	6	-	6
Concord	38	-	7	-	15	-	24
Lexington	1	-	1	-	1	-	1
Lincoln	-	-	0	-	0	-	0
Total	45	0	13	0	22	0	31
INDIVIDUAL PROPERTIES							
Bedford	59	-	19	-	29	-	44
Concord	218	-	47	-	58	-	106
Lexington	63	-	33	-	39	-	47
Lincoln	-	-	0	-	0	-	0
Total	340	0	99	0	126	0	197
Notes:							
1. Based on research for 2012 <i>ESPR</i> .							
2. Appendix G lists these historic resources.							
3. The number of areas listed is fully or partially within the 55 dBA DNL contour.							

10.16 MHC Inventory and Information from Historic Commissions

None of the historic resources in the MHC Inventory and MACRIS would be within the 65 dB DNL contour for the 2020 or 2030 scenarios. Table 10-16 summarizes by town the number of historic resources in the MHC Inventory and MACRIS that would be within the 55 dB DNL contour for the 2020 and 2030 scenarios.

10.16.1 2020 Scenario

In the 2020 growth scenario, 13 individual and 99 survey areas listed in the MHC Inventory and MACRIS would be within the 55 dB DNL contour.

10.16.2 2030 Scenario

In the 2030 growth scenario, 226 individual and 36 area historic resources listed in the MHC Inventory and MACRIS would be within the 55 dB DNL contour.

10.17 Archaeological Resources

Massport encourages new development in areas with existing impervious surfaces that take advantage of existing infrastructure. Any physical changes proposed near the archaeological sites, which are located in undisturbed portions of the airport, have the potential to affect archaeological resources. These areas would be studied, as appropriate, if a project were proposed that affected a relevant area. Ground disturbance is not contemplated near traffic study intersections, since no physical modifications are proposed for these locations. The following is an assessment of the potential impacts to archaeological resources from the Master Planning areas reviewed for development in 2020 and 2030 and described in Chapter 4, Airport Planning. The four planning areas are Terminal, ATCT Apron, East Ramp, and North Airfield.

10.17.1 2020 Scenario

Development in the 2020 scenario is evaluated for each of the four planning areas described in Chapter 4, Airport Planning. All development evaluated for the East Ramp and ATCT Apron areas will occur on existing impervious ramp and apron and are entirely within areas assessed as having a low archaeological sensitivity. These potential development sites are unlikely to affect potentially significant archaeological resources.

Of the new development concepts being evaluated for the 2020 scenario in the Terminal area, some would be sited on existing impervious and previously disturbed areas while other could be in areas that are presently vegetated and pervious. One new parking area was considered adjacent to the existing surface parking lot and Hanscom Drive. Also, the initial phase of the new Air and Space Museum is contemplated to be completed in the 2020 scenario in a wooded area at the intersection of Hanscom Drive and Old Bedford Road. These projects could affect areas assessed as having a high archaeological sensitivity. Additional archaeological investigation within these areas would be appropriate if these concepts moved forward to planning and design and belowground impacts were proposed.

New development is also evaluated for some areas of the North Airfield planning area, some of which would be in presently pervious land. This work would primarily be located on Massport property previously leased to the Air Force for the trailer park which includes pockets of impervious area where the trailer pads were constructed. The development concepts in the 2020 scenario considered a new apron with access to Taxiways N and R and associated hangars. The sites in the North Airfield area are entirely within areas assessed as having a low archaeological sensitivity, and they are unlikely to affect potentially significant archaeological resources.

10.17.2 2030 Scenario

The development concepts considered for the 2030 scenario augment those discussed above in the 2020 scenario and the potential effects on archaeological sensitive areas would be similar. Construction activity in the East Ramp and ATCT Apron areas would continue to be confined to existing impervious areas previously disturbed with low archaeological sensitivity.

Additional development concepts in the Terminal area could include an additional surface parking area, a second phase for the Air and Space Museum, and a placeholder for a hotel along a new road connecting Hanscom Drive with the West Ramp. These projects areas are presently vegetated and considered to have high archaeological sensitivity due to their undisturbed state. Additional archaeological investigation would be recommended if these concepts moved forward to planning and design and belowground impacts were proposed.

In the North Airfield area, most of the augmented development is contemplated for the area around the existing Navy hangar which is presently impervious buildings and apron. There could be some minor increases in impervious area but much would be adjacent to the existing development in areas considered to be of low archaeological sensitivity.

10.18 Minute Man National Historical Park

This section assesses potential noise and traffic effects of the 2020 and 2030 scenarios on the MMNHP. Specific areas of focus include the NPS's goals of physical protection and restoration of Battle Road; road traffic, public safety, and access to park facilities, particularly regarding speed and traffic congestion; management of air traffic to protect the visitor's experience in the park; and the future of Hanscom AFB. Noise level analyses identified DNL and TA values at contributing resources within the park and estimates of acreage of park within the 55 dB DNL contour for the 2020 and 2030 scenarios. Table 10-18 presents the sites with the ten highest DNL values in the Park.

The evaluation of traffic identifies potential changes in Route 2A traffic volumes that are attributable to Hanscom Field. Chapter 6, Ground Transportation describes Massport's support for Transportation Demand Management strategies to reduce its contribution to traffic on area roadways and potential traffic management strategies that do not require physical modification to intersections. As described in Chapter 8, Air Quality, there are no adverse effects attributable to air quality in 2012 or the 2020 and 2030 scenarios.

10.18.1 2020 Scenario

The environmental effects of traffic and noise on MMNHP from Hanscom planning concepts in the 2020 scenario are presented below.

10.18.1.1 Noise

In the 2020 scenario, none of the MMNHP would be within the 65 dB or the 55 dB DNL contour. The DNL values at MMNHP sites would range from 43.9 dB to 54.5 dB. The highest level (54.5 dB) would occur at The Wayside-Samuel Whitney House (MM-7).

None of the 4.9 mile Battle Road Trail would be within the 65 dB DNL or 55 DNL contour in the 2020 scenario. It should be noted that a visitor to the Battle Road portion of the park is affected by the background noise of road traffic from Route 128/I-95 and Route 2A throughout most of the day.

Table 10-17 DNL Values of Sites in the Minute Man National Historical Park (in dB)

Label ¹	Name ²	Unit/Town ³	2005	2012	2020	2030
MM-7	The Wayside (Samuel Whitney House) *	Wayside Unit / Concord	53.6	50.3	54.5	55.3
MM-13	Noah Brooks Tavern (and Carriage House)	Battle Road Unit / Lincoln	53.4	51.4	54.1	54.6
MM-14	Job Brooks House	Battle Road Unit / Lincoln	53.0	51.5	53.6	54.1
MM-12	Samuel Brooks House	Battle Road Unit / Concord	52.5	50.8	53.1	53.7
MM-9	Meriam House	Battle Road Unit / Concord	52.1	50.6	52.9	53.9
MM-8	Meriam's Corner Monument	Battle Road Unit / Concord	51.9	50.3	52.6	53.6
MM-15	Joshua Brooks, Jr. House	Battle Road Unit / Lincoln	51.7	50.7	52.2	52.8
MM-10	Historic Farming Fields	Battle Road Unit / Concord	51.4	50.7	52.1	53.0
MM-1	Major John Buttrick House	North Bridge Unit / Concord	51.2	48.7	52.1	53.2
MM-2	NPS Headquarters and Visitor Center at 174 Liberty St. (Stedman Buttrick Residence)	North Bridge Unit / Concord	50.5	48.3	51.4	52.5
MM-11	Olive Stow House/Farwell Jones House/ Carty Barn	Battle Road Unit / Concord	50.5	49.2	51.3	52.0
MM-31	Col. James Barrett Farm *	Barrett Farm Unit/Concord	n/a	43.5	43.9	44.9

Notes:

1. The MMNHP is a national historic landmark district. All sites are in the National Register of Historic Places. The sites with the ten highest DNL values in 2012 are listed in order of their 2012 DNL value.
2. Sites within MMNHP are marked with an asterisk (*) if they are individually listed in the National Register of Historic Places. Co. James Barrett Farm has been added to the MMNHP since the 2005 *ESPR*.
3. Sites in the Battle Road Unit are located on the Battle Road Interpretive Trail.

The DNL, TA65 and TA55 values at noise analysis locations along the Battle Road Trail were plotted in Figures 10-12 through 10-14 from the Fiske House Foundation (Mile 0) to Meriam's Corner Monument (Mile 5.5). Figures 10-12 through 10-14 indicate that predicted DNL and Time Above values along the trail are highest west of the Hartwell Tavern, reflecting the proximity of these sites to runways at Hanscom Field.

TA65 values ranged from one to thirteen minutes at the thirty noise analysis locations with the highest levels occurring at The Wayside-Samuel Whitney House (MM-7) in the 2030 scenario. TA55 values ranged from 19 to 90 minutes with the highest levels occurring at the Historic Farming Fields (MM-10) in the Bedford Levels in the 2030 Scenario.

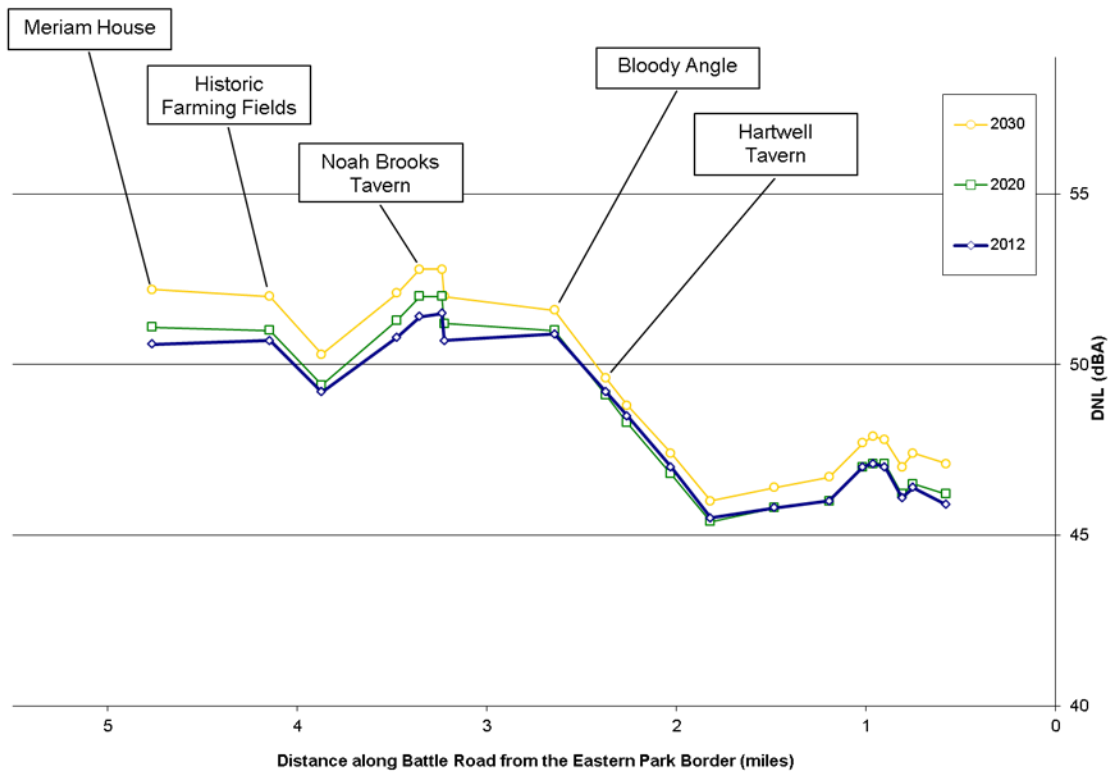


Figure 10-12 DNL at Minute Man National Historic Park Battle Road Unit Locations

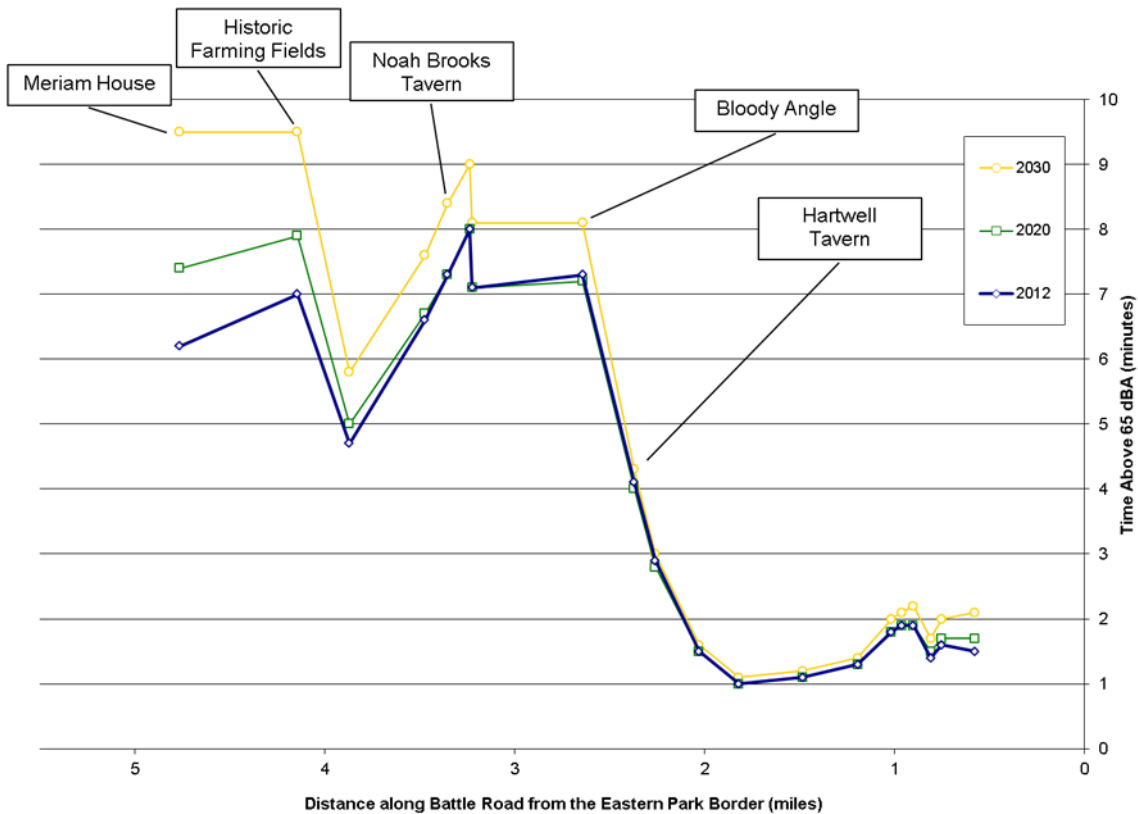


Figure 10-13 Time Above 65 dBA at Minute Man National Historic Park Battle Road Unit Location

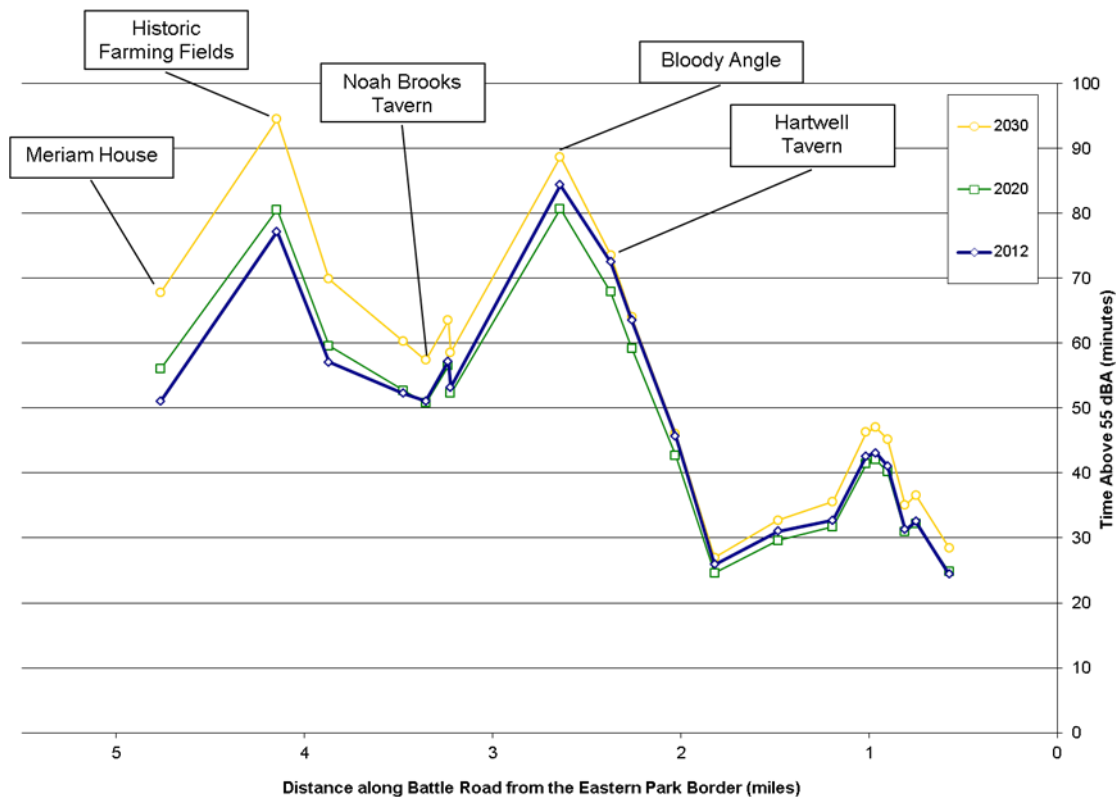


Figure 10-14 Time Above 55 dBA at Minute Man National Historic Park Battle Road Unit Locations

10.18.1.2 Traffic

Hanscom Field traffic remains a very small percentage of the overall volumes on the roadway in the 2020 scenarios. In 2012, Hanscom Field represented four percent of peak hour traffic on Route 2A. Hanscom Field traffic would represent five percent of peak hour volumes in the 2020 scenario and seven percent of peak hour volumes in the 2030 scenario. Hanscom AFB and other local and regional traffic sources account for the rest of the traffic volumes.

In the 2020 scenarios, Hanscom Field traffic would exceed ten percent of a single traffic movement at only one intersection on Route 2A in the MMNHP #6) Hanscom Drive/Route 2A in Lincoln.

10.18.2 2030 Scenario

The environmental effects of traffic and noise on MMNHP from Hanscom planning concepts in the 2030 scenario are presented below.

10.18.2.1 Noise

In the 2030 scenario, none of the MMNHP would be within the 65 dB DNL contour. The predicted DNL values at MMNHP sites would range from 44.9 dB to 55.3dB. The highest predicted level (55.3 dB) would occur at The Wayside-Samuel Whitney House (MM-7). In the 2030 scenario, 0.4 acres of the MMNHP would be within the 55 dB DNL contour up from 0 acres in the 2020 scenario.

None of the 4.9 mile Battle Road Trail would lie within the 55 or 65 dB DNL contour in the 2030 scenario.

TA65 values would range from one to 20 minutes at the thirty noise analysis locations, with the highest levels occurring at The Wayside-Samuel Whitney House (MM-7) in the 2030 scenario. TA55 values would range from 21 to 127 minutes, with the highest predicted levels occurring at the Historic Farming Fields (MM-10) in the Bedford Levels. Similar to the 2020 scenario, DNL and Time Above values, along the trail would be highest west of the Hartwell Tavern.

10.18.2.2 Traffic

Even in the 2030 planning scenarios, Hanscom Field traffic remains a relatively small percentage of the overall roadway volumes. In 2012, Hanscom Field represented four percent of peak hour traffic on Route 2A. Hanscom Field traffic would represent seven percent of peak hour volumes in the 2030 scenario. Hanscom AFB and other local and regional traffic sources account for the rest of the traffic volumes.

In the 2030 scenarios, Hanscom Field traffic would exceed ten percent of a single traffic movement at four intersections on Route 2A in the MMNHP: #2) Route 2A/ Massachusetts Avenue; #3) Route 2A/Old Massachusetts Avenue; #4) Route 2A/Airport Road; and #6) Hanscom Drive/Route 2A;. Delays would increase on the Hanscom Drive approach to the Hanscom Drive/Route 2A intersection and a traffic control officer could be considered for morning peak hour in the 2030 scenario. Average delay on the northbound Bedford Road left-turn at Route 2A would also increase by ten to 20 seconds due to Hanscom Field traffic volumes.

10.18.3 Recreational and Conservation Lands

The 2020 and 2030 scenarios would not result in alterations to recreational and conservation lands. However, there would be incremental noise increases from operating aircraft. Table 10-19 summarizes the predicted changes in noise exposure for the Minuteman Commuter Bikeway, Narrow Gauge Rail-Trail, Hartwell Town Forest/ Jordan Conservation Area, Great Meadows National Wildlife Refuge, and the Concord River.

Impacts within the 65 dB threshold which the FAA uses as a standard to assess significance are limited to a small area of less than an acre of the Hartwell Forest. None of the other noted areas would be with the 65 dB contour.

Impacts within the 55 dB threshold are identifiable for most of the noted areas with the exception being the narrow gauge trail which has no impact. The largest predicted increases are at the Hartwell Forest given its close proximity to Runway 23 end. Impacts within the 55 dB contour also occur in the Great Meadows National Wildlife Refuge. Aircraft fly directly over the Concord Impoundments on a regular basis. The Concord Impoundments are a popular location for bird watching and visits by school groups. To the extent that noise levels can be reduced in the Refuge, it will also benefit nearby residents of Concord along Bedford Street. However, except for implementation of noise abatement takeoff procedures (which many pilots already use), mitigation strategies aimed at protecting open space areas would necessarily redirect aircraft over other populated areas around Hanscom and are not likely to be desirable solutions for most residents.

Table 10-18 Noise Effects on Recreational and Conservation Resources

	Total Distance or Acreage	2005	2012	2020	2030
Within 65 DNL Contour¹					
Minuteman Commuter Bikeway	10.1 miles	0 miles	0 miles	0 miles	0 miles
Narrow Gauge Rail-Trail	3.0 miles	0 miles	0 miles	0 miles	0 miles
Hartwell Town Forest/ Jordan Conservation Area	165.9 acres	1.4 acres	0.1 acres	0.1 acres	0.9 acres
Great Meadows National Wildlife Refuge	3,409 acres	0 acres	0 acres	0 acres	0 acres
Concord River ²	6.5 miles	0 miles	0 miles	0 miles	0 miles
Within 55 DNL Contour					
Minuteman Commuter Bikeway	10.1 miles	1.3 miles	0.3 miles	0.4 miles	0.5 miles
Narrow Gauge Rail-Trail	3.0 miles	0 miles	0 miles	0 miles	0 miles
Hartwell Town Forest/ Jordan Conservation Area	165.9 acres	118 acres	66.4 acres	72.1 acres	95.8 acres
Great Meadows National Wildlife Refuge	3,409 acres	210 acres	26.4 acres	43.1 acres	94.4 acres
Concord River ²	6.5 miles	0.5 miles	0 miles	0 miles	0.1 miles
Notes: 1. This is the exposure level that the Federal Aviation Administration identifies as a guideline for determining potential land use incompatibilities. 2. Concord River is approximately 6.5 miles in length from State Route 2 (South of Airport) to State Route 225 (North of Airport).					

10.19 Environmentally Beneficial Measures

This section presents a summary of possible environmentally beneficial measures that have been identified to address the predicted effects of Hanscom Field on historical and cultural resources in the 2020 and 2030 scenarios. The development and implementation of these improvements would occur in the future in response to actual conditions and anticipated environmental effects. More discussion of potential strategies is presented in Chapter 12, Environmentally Beneficial Measures.

10.19.1 Historical Resources

The inclusion of several tiered categories of information about historic resources in the 2012 *ESPR* provides a comprehensive basis for future analyses in the event that a specific project is developed for implementation. These include the up-to-date compilation of National and State Registers-listed historic resources, the data on current MHC Inventory and MACRIS resources; and the results of the 2006 historic resources reconnaissance survey and 2012 update to capture other historic resources that are 50 years old or older. Traffic measures in Chapter 12, Environmentally Beneficial Measures focus on TDM and operational improvements that do not require physical changes to the roadways. Possible noise mitigation measures could include operational measures of a voluntary nature such as those reported in Chapter 12, Environmentally Beneficial Measures.

10.19.2 Archaeological Resources

Any proposed future activities under the 2020 and 2030 scenarios that involve ground disturbance in areas of archaeological sensitivity or near known archaeological sites have the potential to impact known archaeological resources. The 2006 reconnaissance survey and 2012 update will guide future studies to identify and evaluate these areas in the event that a specific project is contemplated. Possible measures, if they are needed, may include project design approaches to avoid an archaeological site or sensitive area, site protection during construction, or data recovery excavations if a site cannot be avoided.

10.19.2.1 Minute Man National Historical Park

TDM approaches can reduce traffic volumes at a regional level and at Hanscom Field. A traffic control officer could be used during morning peak hours at the Hanscom Drive/Route 2A intersection if volumes reach 2020 and 2030 forecast levels. Possible noise mitigation strategies to reduce effects on historical sites could include continued operational measures of a voluntary nature such as those reported in Chapter 12, Environmentally Beneficial Measures. The federal interagency working group that was formed to review impacts on MMNHP may provide specific recommendations in the future that should be considered. Future noise recommendations may also be derived from the NPS soundscape plan for MMNHP.

11 Sustainable Development and Environmental Management System (EMS)

Sustainability is good for the environment and also makes good business sense. Massport recognizes the importance of sustainability and seeks to incorporate and encourage sustainable practices as an integral part of the agency's general operating and development philosophy.

Massport's mission is "to promote economic growth and vitality throughout Massachusetts and New England by operating many of the region's largest transportation facilities safely, securely, and efficiently while being mindful of the environment and our neighboring communities." In addition, Massport is committed to its pursuit of improving overall sustainability performance of the agency's operations and projects. In keeping with this mission, Massport manages Hanscom Field and its operations in a responsible fashion that considers the operational needs of the airport within the broader context of its environment.

11.1 Key Findings Since 2005

Massport is a leader among Massachusetts agencies in the promotion and implementation of sustainable design and operations. This is reflected in two relevant examples: Logan Terminal A, the first terminal in the world to achieve Leadership in Energy and Environmental Design (LEED) certification⁸⁴; and Hanscom Field being the first airport in the U.S. to achieve ISO 14001 certification. The new Rental Car Facility and the recently completed Green Bus Depot at Logan are also anticipated to achieve LEED Silver certification.

Massport requires that all new development, including that conducted at Hanscom, meet performance standards established by LEED for Silver certification. LEED certification is achieved through the incorporation of sustainability commitments in building design and operation including energy efficiency, use of environmentally-friendly products, reuse and recycling, and renewable energy. At Hanscom, as an example, the new Liberty Mutual Hangar, while not a LEED certified facility includes a range of environmentally friendly elements to reduce energy utilization and environmental management. Rectrix Aviation is constructing a new state-of-the-art fixed-base operator (FBO) facility to replace Hangar 24 and is expected to achieve LEED Silver certification. Massport has constructed solar photovoltaic (PV) panels on the Hanscom Civil Air Terminal Building to provide onsite renewable energy and reduce its demand for power from offsite electricity sources. Massport will continue to encourage future operation and development of Hanscom Field facilities to be performed in a sustainable manner.

⁸⁴ The U.S. Green Building Council developed the LEED Green Building Rating System® to rate the sustainability of different building types.

11.2 Concept of Sustainability

Sustainability is a perspective that integrates economic development and environmental stewardship while meeting societal needs. In planning, design, construction, and operations, the conventional method of problem-solving typically considers short-term economic parameters, such as capital costs. While this consideration remains central to a benefit-cost analysis, the inclusion of operations and maintenance issues are critical for meeting long-term economic and societal goals. In particular, a sustainable approach to planning, design, construction, and operations considers all three elements: economy, environment, and society. Also called the “triple bottom line” (TBL), this approach to sustainable solutions is characterized by an appropriate and optimal balance among the three TBL elements, in addition to considering long-term implications. The long-term perspective is often carried out through life-cycle accounting or scenario planning and can uncover hidden TBL costs, such as potential regulatory changes, increases in the cost of fuel, impacts of climate change on airport operations, and future public demands. In general, sustainable solutions derived from TBL approaches can be expected to be more durable, effective, and economically viable.

The broad definition of sustainability, which acknowledges the inter-relationships among economic, environmental, and societal needs, is presented and discussed below.

11.2.1 Defining Sustainability

In keeping with the sustainability concepts described above, sustainability is a practice in which the use of renewable resources is balanced against their current and future availability, as well as the individual and commercial needs for those resources. It is based on the principle that consumption of resources should not lead to their exhaustion or to permanent damage.

Sustainable development was defined by the World Commission on Environment and Development in 1987 as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”⁸⁵ This definition is widely accepted because the use of natural resources includes not only their direct consumption in processes but also encroachment upon nature through development and land use. It is common to use the terms “sustainability” and “sustainable development” interchangeably.

To be successful, sustainability must be initiated at all levels of a community—from the individual citizens to large public and private organizations. To date, sustainability has achieved its greatest success through voluntary programs, wherein citizens, organizations, and businesses formulate plans that balance the needs of economic prosperity with environmental health. For example, the sustainability reporting movement began around 2000 and is now considered standard practice among private and public corporations. In the last decade, many municipal organizations such as utilities, cities, and airports have begun this practice as well. While guidance for sustainability reporting is well codified by the Global Reporting Initiative, it is still a voluntary undertaking by public and private organizations in the United States.

In the green building arena, the LEED green building rating system has been adopted as part of many local and state building codes. For example, many cities now require new development projects above a specified footprint area to achieve LEED Silver certification. Looking ahead, greenhouse gas (GHG)

⁸⁵ World Commission on Environment and Development (WCED). 1987. *Our Common Future*, the Report of the Brundtland Commission, published by Oxford University Press.

inventorying and reporting—already required for specific industry sectors—is an area in which future regulations can be expected. Already, voluntary GHG mitigation programs have been established by many states and local jurisdictions.

In the Commonwealth of Massachusetts, sustainability has been codified in several ways since the 2005 Environmental Status and Planning Report (ESPR), including Executive Order 484 (Leading by Example: Clean Energy and Efficient Buildings) and the Global Warming Solutions Act (to reduce GHG emissions and adapt to climate change).

11.2.2 State of Practice in Airport Sustainability

Since 2005, numerous advances in aviation sustainability have taken place and many airports have developed sustainability management plans, instituted practices, educated staff, communicated with stakeholders, and begun to track sustainability performance. Massport continues to stay abreast of these advancements and is participating in some of them, such as the Federal Aviation Administration (FAA) Sustainable Master Plan Pilot Program.⁸⁶

For agencies managing airports, some of the recent sustainability advances and resources now available include the following:

- Global Reporting Initiative's (GRI) Airport Operators Sector Supplement, providing guidance for sustainability reporting.
- Sustainable Aviation Guidance Alliance (SAGA) Database, providing a comprehensive list of sustainability strategies, practices, and technologies at airports.
- Airport initiatives: Sustainable airport manuals, master plans, and projects at multiple airports, such as Portland International (PDX), Sky Harbor (PHX), and Denver International (DIA).
- The Airports Council International North America (ACI-NA) environmental steering committee, of which Massport is a member, published environmental goals for North American airports in 2009. The goals covered environmental policies and management systems, air quality, climate, energy, noise, waste management, and water quality.⁸⁷
- Multiple research efforts conducted under the Airport Cooperative Research Program (ACRP), including:
 - ACRP Synthesis 10: Airport Sustainability Practices
 - ACRP Project 02-28: Sustainability for Airports: Best Practices, Success Metrics, and Beyond
 - ACRP Project 02-30: Enhancing the Airport-Industry Database of Sustainable Practices
 - ACRP Report 42: Sustainable Airport Construction Practices
 - ACRP Project 02-40: Climate Change Adaptation Planning: Risk Assessment for Airports
 - ACRP Project 09-06: Sustainable Practices for Airport Maintenance and Operations

In addition, the FAA has been active in sustainable aviation through the following efforts:

- Existing and new noise compatibility programs (see Federal Aviation Regulations Part 150)
- Voluntary Airport Low Emissions (VALE) Program
- *Technical Guidance for Evaluating Selected Solar Technologies at Airports* (The Solar Guide)

⁸⁶ FAA website, Sustainability page, accessible at <http://www.faa.gov/airports/environmental/sustainability/>.

⁸⁷ ACI (February 2009), ACI-NA Environmental Goals. Accessible at http://www.airportsgoinggreen.org/Content/Documents/ACI_NA_board_enviro_goals_feb6.pdf

- Provisions in the FAA Reauthorization Act of 2012 for recycling and energy management

Most notably, the FAA initiated a Sustainable Master Plan Pilot Program in May 2010, to promote industry-wide learning about effective sustainability practices in master planning and operational management. Logan Airport, owned and operated by Massport, is one of the pilot locations for this program. Under a federal grant, Logan Airport is developing a Sustainability Management Plan. Massport is also undertaking a long-term strategic plan and a climate adaptation plan. Massport expects that practices and lessons learned at Logan will be applied as practicable to Hanscom Field and other Massport facilities.

11.2.3 Guiding Principles

As described above, the state of aviation practice has evolved considerably in the last several years; however, the fundamental guiding principles for airport sustainability have remained unchanged. At the highest level, as articulated by The Natural Step,⁸⁸ a global non-profit sustainability education and training organization, these guiding principles include the following:

- Reduce reliance upon non-renewable resources such as fossil fuels, metals, and minerals.
- Reduce consumption of chemicals and other synthetic compounds that are not easily assimilated by biological systems.
- Reduce or reverse the progressive degradation of natural systems resulting from development and other human activities.
- Help people meet their hierarchy of economic and social needs in fair and efficient ways.

Translated into terms applicable to airports, these general sustainability guiding principles address the following airport action areas as reported in ACRP Synthesis 10, Airport Sustainability Practices:

- Promote environmental sustainability through protecting water and air quality, adapting to climate change, reducing GHG emissions, stewarding land resources, preserving biodiversity, selecting environmentally preferable materials, minimizing and eliminating waste, recycling, abating noise, reducing energy consumption and efficiency, building green buildings, and implementing efficient transportation systems.
- Promote social sustainability by promoting aesthetics, communicating via public relations and stakeholder engagement, following fair and beneficial employee practices and procedures, promoting transportation mobility and accessibility solutions, celebrating local culture and heritage, safeguarding health/safety/indoor environmental quality, and promoting employee and passenger well-being.
- Promote economic sustainability through local hiring and purchasing, making contributions to the community, quantifying the economic metrics of sustainable solutions, contributing to research and development, participating in local economic development, and monetarily incentivizing sustainable behavior (for example, though lease terms with tenants).

11.2.4 State-Level Guidelines, Initiatives, and Programs

Massport voluntarily ascribes to and supports various sustainability guidelines, initiatives, and programs that are promulgated and promoted by the Commonwealth of Massachusetts. These are described in the following subsections.

⁸⁸ The Natural Step, Four System Conditions and Principles of Sustainability, accessible at <http://www.naturalstep.org/the-system-conditions>.

11.2.4.1 Executive Order 385 Planning for Growth (1996)

Massport voluntarily follows to the guidelines of Executive Order 385 Planning for Growth.⁸⁹ Key features of Executive Order 385 include the following:

- Massachusetts supports economic development that does not result in preventable adverse environmental effects.
- Massachusetts promotes development that is designed to minimize environmental impacts.
- The preferred method of achieving sustainability is through voluntary actions of involved parties.
- All Commonwealth agencies are to analyze the effect of their operations on their ability, and the ability of others, to implement sustainability and, when necessary, practical, and feasible, make changes to prevent any hindrances to achieving sustainability.
- All agencies shall try to work within the local or regional growth management plans.
- Reuse and rehabilitation of existing facilities and infrastructure are preferred over new facilities and infrastructure, where practicable and consistent with other plans.
- Regional transportation planning shall be coordinated among all involved agencies.

11.2.4.2 Executive Order 438 State Sustainability Program (2002)

In 2002, Massport began participating in the new State Sustainability Program (Executive Order 438)⁹⁰ developed by the Executive Office of Environmental Affairs. This program was an expansion of the Clean State Program, in which Massport had actively participated for many years.

The State Sustainability Program was designed to encourage state agencies to promote environmentally sustainable practices—including green buildings—to reduce environmental impacts from operations and to increase energy efficiency. Green building is the design, construction, and/or renovation of buildings that achieve energy efficiency and environmental sustainability. Massport has taken a leadership role in ensuring that its facilities meet LEED Silver criteria, including requiring third-party developers to meet the same standard.

11.2.4.3 Executive Order 484 Leading by Example—Clean Energy and Efficient Buildings (2007)

Executive Order 484⁹¹ was signed by Governor Deval Patrick in 2007. It requires that state agencies lead by example to promote clean energy and efficient buildings. The Executive Order states that because buildings are significant users of energy, water, and natural resources, and because the Commonwealth manages millions of square feet of buildings, state agencies must prioritize energy conservation practices and programs that will reduce consumption of fossil fuels and measure progress towards clean energy and environmental goals. The Executive Order also requires that long-term programs, such as the Lead by Example Program, be established to identify and implement cost-effective initiatives that will result in environmental improvement and offer educational and training efforts in order to carry out the mandate of Executive Order 484.

⁸⁹ Governor William F. Weld, Executive Order No. 385 Planning for Growth, April 23, 1996. Accessible at <http://www.lawlib.state.ma.us/source/mass/eo/eotext/EO385.txt>

⁹⁰ Governor Jane M. Swift, Executive Order No. 438 State Sustainability Program. Accessible at <http://www.lawlib.state.ma.us/source/mass/eo/eotext/EO438.txt>

⁹¹ Governor Deval L. Patrick, Executive Order 484, Leading by Example: Clean Energy and Efficient Buildings. Accessible at <http://www.mass.gov/governor/docs/executive-orders/leading-by-example-eo.pdf>.

11.2.4.4 Global Warming Solutions Act (2008)

The Global Warming Solutions Act (GWSA) was signed into law in August 2008, thereby establishing a comprehensive regulatory program for the Commonwealth to address climate change. The GWSA required the setting of economy-wide GHG emission reductions to reduce emissions between 10 percent and 25 percent below statewide 1990 levels by 2020, and 80 percent below 1990 levels by 2050. Massport's Energy Efficiency Initiative implements the goals of this act through energy efficiency and renewable energy installations.

11.2.4.5 MassDOT's GreenDOT Program (2010)

In June 2010, the Massachusetts Department of Transportation (MassDOT) launched the GreenDOT program to work toward three primary goals: reduce GHG emissions; promote the healthy transportation options of walking, bicycling, and public transit; and support smart growth development. GreenDOT calls for MassDOT to incorporate sustainability into all of its activities from strategic planning to project design and construction to system operation. The initiative includes GHG reduction targets mandated under the GWSA. The implementation plan centers around 16 sustainability goals under Air, Energy, Land, Materials, Policy/Planning, Waste, and Water. Massport was already aligning with these sustainability goals even before the formal implementation plan, and many of these activities are described below.

11.2.5 Massport's Environmental Management Policy

In November 2000, the Massport Board approved the Environmental Management Policy that states:

Massachusetts Port Authority (Massport) is committed to operate all its facilities in an environmentally sound and responsible manner. Massport will strive to minimize the impact of its operations on the environment through the continuous improvement of its environmental performance and the implementation of pollution prevention measures, both to the extent feasible and practicable in a manner that is consistent with Massport's mission and goals. To successfully implement this policy, Massport will develop and maintain management systems that will:

- Ensure that the environmental management policy is available to staff, tenants, customers and the general public.
- Ensure compliance with all applicable laws and regulations.
- Ensure that environmental considerations are included in the business, financial, operational, and programmatic decisions, including feasible and practicable options for potentially exceeding compliance with applicable regulatory requirements.
- Define and apply sustainable design principles in the planning, design, operation and decommissioning of its facilities.
- Define and establish environmental objectives, targets, and best management practices and monitor performance.
- Provide training to and communication with staff and affected tenants regarding environmental goals, objectives, and targets and their respective roles and responsibilities in fulfilling them.
- Incorporate monitoring of Massport and Massport tenants' environmental activities.
- Include the preparation of an annual environmental performance report, which will be made available to staff, tenants, customers and the general public.

11.2.6 Environmental Management Systems

The ISO 14000 series of international standards addresses environmental issues associated with the activities, products, or services provided by an organization. The standards are designed to be incorporated into organizations of any type and size. The voluntary program involves creating an Environmental Management System (EMS), a proactive environmental program promoting pollution prevention, sustainable development, and continuous improvement. An International Standards Organization (ISO)-certified EMS must include a corporate environmental policy, environmental performance evaluation, and comprehensive system auditing. This process allows for continual evaluation and improvement in environmental performance.

ISO 14001 environmental management systems are being adopted around the world under the Aviation Environmental Management System (AEMS). Hanscom was the first U.S. airport to obtain ISO 14001 certification in 2001. Since then, other airports have followed suit, including Logan, Dallas/Ft. Worth, Denver, and Westchester County. A number of European airports, including Dublin, Cannes Mandelieu, Torp Sandefjord (Norway), Brussels, Hamburg, and Heathrow, as well as Toronto Pearson Airport, Vancouver International, and Aeroports de Montreal in Canada, are ISO 14001 certified or compliant.

11.2.7 LEED Certification

The U.S. Green Building Council (USGBC) established the LEED Green Building Rating System in 2000. “LEED is a third-party certification program and nationally accepted benchmark for the design, construction, and operation of high performance green buildings. LEED certification is available for various building types including new construction and major renovation; existing buildings; commercial interiors; core and shell; schools and homes. LEED systems for neighborhood development, retail and healthcare are currently pilot testing. To date, there are over 4.5 billion square feet of construction space involved with the LEED system.” According to the USGBC and substantiated by many case studies, buildings benefit from LEED certification by:

- Costing less to operate and maintain.
- Generating higher energy- and water-efficiencies.
- Demonstrating higher lease-up rates than conventional buildings in their markets.
- Providing a healthier and safer indoor environment for occupants.
- Embodying the environmental or sustainability values of the organizations that build, own, and occupy them.

The USGBC has a defined process to grant LEED certification. Building designs are registered with USGBC for review, which includes third-party validation. Buildings are certified based on whether they achieve a minimum number of points that are based on the number of “green” design elements that are in the design. One innovation in the LEED system since 2005 is that the rating system now includes regional credits. Projects can earn up to four “bonus” credits for implementing green building strategies that address the important environmental issues facing their region.⁹² A rating system is used to determine four levels of LEED certification (Certified, Silver, Gold, and Platinum). The USGBC also provides training and accreditation for design professionals.

⁹² U.S. Green Building Council. Fact Sheet. Available at <http://new.usgbc.org/sites/default/files/Docs3330.pdf>.

11.3 Sustainable Development at Hanscom Field

There are many strategies and practices available that support sustainable development. Since the 2005 *ESPR*, Massport has developed and implemented sustainability initiatives appropriate to an airport environment, as well as to the particular location and role of Hanscom Field. A keystone of its overall program, Massport requires LEED Silver certification for all new development. This section provides details of Massport's current and planned sustainability practices at Hanscom Field.

11.3.1 Environmental Management System

In May 2001, Hanscom Field became the first airport in the U.S. to receive ISO 14001 certification through the development and implementation of an Environmental Management System (EMS). This achievement is a cornerstone for Massport in defining and achieving its sustainability goals and set a course for other Massport facilities.

A key feature of the EMS is a focus on continuous improvement by setting objectives and targets that are achieved and updated at regular intervals. Hanscom's focus areas for the EMS are related to vehicle emissions, energy use, solid waste recycling, stormwater management, hazardous materials, and tenant training.

In addition, employees are regularly trained to ensure awareness of risks to the environment associated with their jobs, to support continued ISO 14001 certification, and to maintain continuous improvement. Training topics include compliance requirements such as the management of hazardous materials and waste, stormwater pollution prevention, and spill prevention and response.

Massport's ISO 14001 certification requires having a third-party audit the system to ensure that it demonstrates continued improvement. These audits are performed by an internal auditor and then by a third-party auditor, typically every three years.

Hanscom Field is continuously improving the EMS itself by working toward greater staff engagement, improving information flows, and maintaining better documentation. In this regard, management review is a key element to the EMS at Hanscom Field. Senior managers regularly review the EMS, ensure adequate resources are available, and determine next steps. A management review meeting is held regularly to review the results of periodic audits and to determine if changes to the system are required.

11.3.2 Environmental Sustainability Initiatives

Massport is committed to minimizing the impact of its operations on both the natural and human environments through a wide array of initiatives and programs, in addition to those included in the EMS. Initiatives to promote sustainability include:

- Sustainable Planning and Design
- Sustainable Construction
- Sustainable Operations and Maintenance
- Monitoring of Environmental Performance

The beneficial effects to the environment of these initiatives extend across a variety of media, including air, water, noise, waste, and energy. The following sections, organized by the four initiatives listed above, highlight activities since 2005 and describe current program elements.

11.3.3 Sustainable Planning, Design, and Construction

Massport follows a formal sustainable planning, design, and construction program, which is applied at Hanscom Field. In addition to requiring LEED Silver certification, the program established specific criteria for designer selection and design review, design guidelines, and requirements for use of green technologies that foster the efficient use of resources such as energy, water, and air. These technologies include natural day-lighting, passive solar gain, natural cooling, energy-efficient HVAC equipment, environmentally beneficial building materials, and renewable energy and energy use monitoring.

To support this program, Massport adopted a comprehensive set of standards and guidelines for sustainable design in 2009, followed by Version 2 in 2011. The Sustainable Design Standards and Guidelines (SDSG) document currently applies to Massport projects in the capital program. Tenants and third-party developers are encouraged to follow the SDSG, which covers the following areas:

- General standards relating to project management, documentation, public involvement, commissioning, operational programs and infrastructure, and other topics
- Project site design
- Project materials
- Energy management and efficiency
- Air emissions
- Water management quality and efficiency
- Indoor air quality and occupant comfort

11.3.3.1 LEED Certification

Under the LEED certification program, Massport requires building projects (new or rehab projects) greater than 20,000 square feet in size to meet sustainable design elements and achieve a minimum LEED Silver certification. Designers are encouraged to achieve higher levels of LEED certification through the incorporation of appropriate sustainable design and operational elements. The Rectrix Hangar, to be completed in 2013, is anticipated to be LEED Silver certified upon completion. The key green features for these facilities include day-lighting, energy-efficient systems, and environmentally sustainable materials.

11.3.3.2 Energy Efficiency and Renewable Energy

Energy efficiency and renewable energy requirements are often stipulated in the environmental permitting documents and commitments as well as lease agreements. In addition to following the SDSG and supporting the LEED credits for energy in new or rehabilitated buildings, Hanscom Field has invested a significant effort into post-construction energy-efficiency projects.

The new roofing system for the Civil Air Terminal includes a 51 kilowatt solar PV facility comprised of 222 solar panels. Testing and commissioning of the system was completed in 2011. The total system was modeled to produce over 57,233 kilowatt-hours (kWh) of electricity per year, or 10 percent of the total building electricity requirement. To date, this installation has produced more than 156,000 kWh of electricity.

As part of the roof replacement project, Massport included increased insulation that is anticipated to decrease heating and cooling demands for the building by an estimated 20 percent as a result of lower heating and cooling demands. It installed new energy-efficient HVAC units in the Civil Air Terminal in August 2012. A dedicated building electricity meter was also installed to provide detailed monitoring of

total building electricity demands and is used to track and verify whole building energy efficiency improvements.

11.3.3.3 Water Efficiency and Wastewater Reduction

In addition to using the sustainable design guidelines in the SDSG and supporting the LEED credits for water efficiency and wastewater reduction in new or rehabilitated buildings, Hanscom Field seeks opportunities to manage water resources more sustainably.

11.3.4 Sustainable Construction

Massport has established requirements for construction contractors that are aimed at minimizing environmental impacts. As part of its project approval process, Massport requires contractors to adhere to construction guidelines relating to:

- Construction debris and demolition waste recycling
- Selection of high-efficiency space heating/cooling systems
- Soil treatment and reuse on site (Soil Management Plan)
- Construction worker vehicle trip limitation
- Clean Construction Initiative, which requires contractors to retrofit their heavy equipment with advanced pollution control devices during construction of all Massport projects

In addition to enforcing the use of the construction guidelines, Massport seeks opportunities to employ more environmentally-friendly technologies. For example, warm-mix asphalt was pioneered at Logan Airport to take advantage of the benefits it offers: less energy required for heating, reducing air emissions, and healthier conditions for workers. At Hanscom Field, warm-mix asphalt was used in the rehabilitation of Taxiway ES-EW and in the resurfacing of the general aircraft parking lot.

11.3.5 Sustainable Operations and Maintenance

Massport has several programs in place that contribute to the sustainable operation and maintenance of the airport and its facilities. These programs are described below.

11.3.5.1 Energy Efficiency

In addition to promoting energy efficiency in planning, design, and construction, Massport strives for continuous improvement in operational energy efficiency. At Hanscom Field, digital energy meters were installed to obtain more accurate energy consumption data.

11.3.5.2 Clean Fuel Vehicle Program

As part of the Clean Fuel Vehicle Program, Massport has made progress in bringing alternative fuel vehicles (AFVs) into its fleet at Hanscom Field. At present, Massport owns fifteen fleet vehicles at Hanscom Field, four of which are electric. In addition, several tenants have switched to electric tugs for moving aircraft, resulting in reduced emissions at the airport. Jet Aviation uses six electric tugs and Signature uses electric two tugs and two electric golf carts.

The primary alternative fuel is ultra-low-sulfur diesel fuel. Massport will continue to consider AFVs for any new vehicle purchase in the future. Any new conventional-fueled vehicle added to the Hanscom fleet in the future will have very low emissions and will automatically comply with the low emission goals of the federal Clean Fuel Fleet Program (40 Code of Federal Regulations Part 88). As part of these regulations, ultra-low-sulfur diesel fuel for on-road diesel vehicles was phased in starting in 2005.

11.3.5.3 Toxic Reductions

Hanscom Field is a Very Small Quantity generator (< 220 lb/month) of Resource Conservation and Recovery Act (RCRA) regulated hazardous waste and a Small Quantity generator (< 2,200 lb/month) of Massachusetts regulated hazardous waste. Massport is committed to reducing the potential for the discharge and release of toxic materials, and pollution prevention is part of Massport's Storm Water Pollution Prevention Plan (SWPPP). Less toxic and non-toxic alternatives are evaluated and implemented where applicable.

Through Hanscom's EMS, Massport periodically looks for ways to reduce the use of toxic materials including evaluation of products for replacements with non-toxic alternatives. For example, solid-form sodium formate was selected for deicing at Hanscom after a careful evaluation of other options that were both FAA-approved and that met Clean Water Act receiving water standards. An inventory of chemicals being used at Hanscom Field is underway to identify other opportunities to reduce toxic compounds. Reduction of toxic materials means that less hazardous waste is produced, thereby minimizing impacts to the environment and saving dollars on waste disposal. In keeping with this goal, potential sources of spills or contamination are also carefully managed. For instance, the aboveground storage tanks at Hangar 10 were removed in August 2011.

Massport also works with its tenants to identify ways to reduce the amount and toxicity of certain products used at Hanscom Field. Massport involves the tenants in achieving environmental compliance and pollution prevention. Massport provides ongoing technical assistance to tenants regarding new regulations and means for compliance through an inspection program conducted by the Environmental Management Unit. In addition, educational materials are distributed on pollution prevention, stormwater best management practices, spill prevention and response procedures, and other topics.

Massport periodically sends tenants reminder notices of upcoming regulatory requirements. Since 2005, these notices covered topics such as recycling, tank management, spill prevention and reporting, stormwater, and universal waste management.

11.3.5.4 Recycling

Since the 2005 *ESPR*, Massport has converted to single-stream recycling, which recycles a wider range of materials than the previous system. Hanscom and tenant facilities are provided with recycling dumpsters. Overall, Massport's recycling rates have steadily risen to approximately 11 to 12 percent for the entire Authority.

Under a new Massport recycling contract, the containers will be changed to a style that can be weighed at the time of service. Hanscom will be outfitted with larger-capacity containers, which will be wirelessly monitored, reducing unnecessary services. These units are available with solar panels as the primary power source, with traditional electrical backup.

Massport's goal is to reduce the cost of waste and recycling at Hanscom by 40 percent, while increasing the recycling rate to 30 to 40 percent during the 2014-2017 timeframe, and eventually to zero waste by 2020. Lastly, the trucks used to collect trash and recycling will be converted to compressed natural gas (CNG) during 2014.

11.3.5.5 Stormwater Management

Massport and its tenants have implemented a number of programs and management practices to reduce the potential for pollutants to be released into the storm drainage system. Many of the ongoing practices

are focused on control of pollutants at their source through education and implementation of source reduction techniques and better administration and handling practices. Examples of ongoing practices include:

- Annual spill, stormwater, and hazardous waste management training for Massport employees
- Spill prevention, control, and countermeasure plan implementation by Massport and its tenants
- Inspection of stormwater discharges
- Placement of floating booms at outfalls
- Monitoring outfall conditions
- Implementation of a tank management program

Massport has also conducted design reviews to ensure that new facilities improve the quality and character of the airport while minimizing environmental impacts. Improved stormwater runoff control has been achieved through the requirement that compensatory storage for stormwater be provided for any projects resulting in increases in impervious surfaces, in order to not increase peak runoff rates.

In addition, Massport strives to take advantage of existing stormwater infrastructure and directs new development to areas with existing impervious surfaces. Massport also identifies and removes existing impervious surfaces where feasible. Since the 2005 *ESPR*, Massport has eliminated approximately 4.4 acres of impervious surfaces at Hanscom Field by removing unused airside pavement.

11.3.5.6 Climate Adaptation

Adaptation to the anticipated impacts of climate change, such as increased frequency and intensity of storms, flooding, and sea level rise, may require adaptive actions at Hanscom Field and potential investments in infrastructure improvements. Hanscom has undertaken several initiatives in this area to become informed and begin securing the assets of the airport. For example:

- Massport managers participated in a statewide climate adaptation dialogue, which resulted in the development of short-, mid-, and long-range goals for addressing climate change within each state agency.
- Massport is evaluating disaster vulnerability, and the resulting report will become the basis for disaster planning.
- Massport has also initiated a long-range strategic planning effort Massport-wide, which includes an element addressing climate adaptation.
- In addition, the results of Logan Airport's climate adaptation work, in association with the development of its Sustainable Management Plan (currently underway), will be translated to Hanscom Field and other Massport facilities through the EMS framework.

11.3.6 Monitoring of Environmental Performance

Massport has in place a number of environmental monitoring and audit programs at Hanscom Field that are required under regulatory programs such as the National Pollutant Discharge Elimination System, Oil Pollution Prevention regulations, and the Clean Air Act. In addition, Massport has in place several proactive policies, procedures, and programs that it has voluntarily adopted to assist in monitoring environmental performance and to identify opportunities to improve Massport's environmental programs.

11.3.6.1 Annual Reporting

As part of the EMS, an annual performance report is compiled, which becomes the basis for selecting new objectives and targets for continuous improvement. This report evaluates environmental performance on a number of parameters, including energy efficiency and watershed protection.

At the beginning of each year, Massport prepares *The State of Hanscom*, which is presented to the Hanscom Field Advisory Commission (HFAC), a legislatively created body comprised of representatives from the surrounding residential areas, area-wide organizations, and members of the aviation community. The presentation to the HFAC provides a wide range of interested parties with an opportunity to openly discuss the role of Hanscom Field in the regional transportation system and Massport's objectives for the airport, including environmental and sustainability activities. In this report, it is noted that Massport meets its environmental commitments using a series of programs that include monitoring and auditing activities at Hanscom to ensure compliance with environmental regulations and the use of pollution prevention practices. Ongoing practices include:

- Using the EMS to track, manage, and improve environmental compliance and performance; updating targets as target dates are reached or when opportunities arise for improving the EMS framework.
- Participating in the Massachusetts State Sustainability Program (Executive Order 438) to promote environmentally sustainable practices and in the Massachusetts Leading By Example—Clean Energy and Efficient Buildings program (Executive Order 484).
- Inspecting Massport and tenant facilities to ensure environmental compliance.
- Reviewing and updating the Spill Prevention Control and Countermeasure (SPCC) Plan, which outlines steps to be taken by Massport employees in the event of a spill of fuel or other hazardous materials.
- Conducting monthly inspections of materials in the Field Maintenance garage that are used to control spills of fuel or other hazardous materials.
- Implementing and encouraging tenants to utilize best management practices (BMPs).
- Conducting periodic water quality inspections at Massport's stormwater outfall locations.
- Participating in an aggressive mixed paper and cardboard recycling program for tenant and Massport offices, which expanded to single-stream recycling in 2009.
- Identifying opportunities during Massport capital program project design development to reduce stormwater runoff and peak flows.
- Identifying opportunities for development projects to control stormwater runoff.

11.4 Social Sustainability Initiatives

In recognition of the triple bottom line, Massport undertakes a number of partnerships and joint efforts with and for external stakeholders. For Hanscom Field, social sustainability emphasizes good community relations, productive stakeholder engagement, charitable contributions, support for education and youth programs, and environmental efforts that create community benefits. Since the 2005 *ESPR* was prepared, Hanscom Field's social sustainability initiatives have included the following:

- For 2011, in celebration of Earth Day, Hanscom conducted a hazardous waste collection event for tenants. The event was a success with over 8,000 pounds of hazardous materials collected.
- Massport has made contributions to various charities and scholarships. Massport's Charitable Contribution, Scholarship, and Community Summer Jobs programs benefit organizations located

in communities that host its facilities. The organizations serve a diverse constituency and a variety of worthwhile purposes.

- In 2012, Massport contributed \$7,000 to educational, scholarship, and youth programs in the Hanscom area. Additionally, Massport provided approximately \$12,000 to sponsor summer internship positions at various municipal departments in the four Hanscom towns and \$24,000 for the salaries of local college students that worked directly for Massport.
- Completing a noise outreach program in conjunction with the National Parks Service.
- Implementing a vegetative management plan with the conservation commissions of the four towns of Bedford, Concord, Lexington, and Lincoln so that the vegetation that grows into Hanscom airspace is managed in an environmentally sensitive manner.
- Opening a 40-acre conservation area with a trail network to the public, which allows users to enjoy the natural surroundings and understand the importance of conservation efforts by Massport.

11.5 Future Sustainability Efforts

Massport's future environmental sustainability efforts at Hanscom Field are expected to include the following:

- Integration with Logan Airport Sustainable Management Plan – Results, findings, and lessons learned from Logan's Sustainable Management Plan can be scaled up and across other Massport facilities, including Hanscom. Any resulting new efforts will be integrated with Hanscom's ongoing environmental management under the EMS and other existing sustainability initiatives.
- Environmental Management System – Hanscom's EMS recertification audit was conducted successfully in March 2013 and resulted in recertification through May 2016.
- Sustainable Design and Construction – Future design and construction efforts will maintain the sustainable design and construction initiatives and identify opportunities to expand the scope to achieve additional benefits. This includes a continued commitment to the initiatives described above.
- LEED Certification – Massport will continue to utilize and require that sustainable design guidelines and LEED certification be met by Massport, tenants, and third-party developers. This effort includes asking third-party developers to adopt good commissioning practices to ensure that facilities operate as designed.
- Energy Efficiency – Hanscom operations staff will investigate opportunities to re-lamp facilities, airfields, and street lights with LED systems. In addition, automatic, power-saver light switches will also be evaluated for installation.
- Renewable Energy – All future development projects will be evaluated for opportunities to incorporate renewable energy installations, such as solar power, wind, passive solar, biomass, or other viable technologies that may become available.
- Water Efficiency and Wastewater Reduction – All future development projects will be evaluated for opportunities to improve water efficiency and wastewater reduction, such as rainwater harvesting; gray water reuse for flushing, irrigation, or vehicle washing; and other technologies that may become available.
- Sustainable Construction – Individual projects will be required to implement BMPs to address Massport's policy regarding stormwater runoff, which requires that projects resulting in increases in impervious surfaces do not increase peak runoff rates.

- Clean Fuel – The existing programs for fuel efficiency and alternative fuel vehicles will be continued under the EMS program.
- Toxic Reductions – The existing program for toxic materials reduction and pollution prevention will be continued under the EMS program.
- Recycling – Massport’s innovative waste management approach, which seeks to create revenue from this former cost center, will begin implementation in late fall 2013. Initial implementation will focus on waste streams controlled by Massport; over time, tenants’ waste streams will be incorporated. Massport will also investigate the practicality of composting.
- Stormwater Management – Massport will continue to improve the management of stormwater runoff at Hanscom Field. This will include the potential elimination of unused paved surfaces (without affecting airport operations) and avoiding any increases in areas of impervious surfaces.
- Climate Adaptation – Massport is reviewing this issue authority-wide through studies that will develop recommendations for its facilities.
- Monitoring of Environmental Performance – The existing EMS program will continue to monitor environmental performance in its focus areas of vehicle emissions, energy efficiency, stormwater management, hazardous materials management, and employee/tenant training.

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12 Environmentally Beneficial Measures

The previous sections assessed the environmental effects of Hanscom Field associated with year 2012 as a baseline, analyzed historic environmental trends using information from past reports, and considered the potential future effects of operations and development scenarios in the planning years 2020 and 2030. The 2012 *ESPR* future scenarios are used to evaluate the potential cumulative environmental effects that could occur if Hanscom Field reaches the airport activity levels that are described in Chapter 3, Airport Activity Levels. The aviation activity forecasts that are described in Chapter 3 provide for a realistic and practical level of growth based on local and national aviation trends including forecasts from the New England Regional Aviation System Plan. The 2020 and 2030 scenarios represent estimates of what could occur (not what will occur) in the future using certain planning assumptions and are not necessarily recommended outcomes. This chapter summarizes the environmentally beneficial actions described in previous chapters that are in place at Hanscom Field as well as those additional measures that could be implemented to avoid or minimize potential environmental effects associated with the future scenarios.

Massport's existing programmed activities encompass stewardship of environmental resources at and near Hanscom Field. Hanscom was the first airport in the nation to be ISO-certified and Massport implements an Environmental Management System (EMS) which includes continually reviewing and expanding the program to meet future environmental effects. Massport is also a leader among Massachusetts agencies in the promotion and implementation of sustainable designs through its Sustainable Design Standards and Guidelines and requirement that all new building development meet LEED Silver Certification. New hangars at Hanscom being developed by Rectrix Aviation and proposed by Jet Aviation are planned to meet this design requirement.

Massport has a long history of noise abatement commitments at Hanscom Field which are based on the 1978 Master Plan and 1980 regulations. These regulations prohibit 11:00 p.m. to 7:00 a.m. touch-and-go activity; prohibit touch-and-go activity by aircraft weighing over 12,500 pounds; and prohibit activity by Stage I Aircraft over 12,500 pounds. Massport's 1980 Regulations also prohibit scheduled commercial passenger services with aircraft having more than 60 seats.

Massport has also worked cooperatively with the local community, aviation groups and the Minute Man National Historical Park (MMNHP) to implement a comprehensive noise abatement program known as "Fly Friendly" guided by the National Business Aircraft Association's (NBAA) published noise abatement guidelines and the Aircraft Owners and Pilots Association (AOPA) noise reduction recommendations. Pilots are encouraged to adhere to safe and quiet flying techniques and to remain aware of noise issues at the airfield. Additionally, Massport developed recommended helicopter procedures and voluntary touch-and-go procedures that help reduce noise over the MMNHP.

Within this context, the *ESPR* process provides a comprehensive evaluation of existing conditions, recent trends and the environmental effects of 2020 and 2030 scenarios. The 2012 *ESPR* provides baseline information for the planning and design of new facilities and serves as a useful resource for the towns of Bedford, Concord, Lexington and Lincoln, Metropolitan Area Planning Council (MAPC), National Park

Service (NPS), Hanscom Air Force Base (AFB), and other interested parties. The existing programs and ongoing efforts to enhance these programs provide the foundation to address the types of conditions that could occur if activity levels are comparable to the 2020 and 2030 scenarios.

In accordance with the EEA Scope Certificate, Table 12-1 presents the responsible parties, implementation schedule, and the estimated cost of environmentally beneficial measures that are presented in the previous chapters. The identified ground transportation measures and others will be assessed through Massport's participation in the MassRIDES Transportation Management Initiative (TMI) program and discussed in Chapter 6, Ground Transportation. Site-specific noise abatement is not proposed since no noise analysis location experiences a DNL value greater than 60 dB in 2012 nor would any site be expected to experience a DNL value greater than 60 dB under the 2020 and 2030 scenarios.

Table 12-1 Summary of Existing and Possible Future Environmentally Beneficial Measures

Measure	Responsible Party	Timetable
GROUND TRANSPORTATION		
Transportation information on Massport website	Massport	Ongoing
Transit information in Civil Air Terminal	Massport	Ongoing
Participation as a partner in MassRIDES Transportation Management Initiative program	Massport	Ongoing
Information about transit and non-auto travel options in prominent locations throughout Hanscom Field	Massport	2014
Bus shelter with transit information	Massport	2014
Exploration of working with local communities and stakeholders on a bikeshare network	Multiple parties including Massport	Ongoing
NOISE		
Modifications to the Fly Friendly Program using the flight tracking software to direct pilots conducting touch-and-go procedures to fly more over the airport than neighboring lands	Massport	Ongoing
Continued implementation of the Fly Friendly program	Massport	Ongoing
Run-up procedures for use of the East Ramp	Massport	Ongoing
Relocation of noise monitors based on input from ongoing community coordination process and implementation of updates to the Noise and Operations Monitoring System	Massport	2014
Creation of the "Airport Activity Monitor" which allows the public to research a noise event or flight, log a noise disturbance, and track correspondence related to a noise disturbance.	Massport	Ongoing
AIR QUALITY		
Continued encouragement of tenants to consider the purchase of alternatively fueled ground service equipment, where appropriate	Massport	Ongoing
Encouragement of Fixed Base Operators to minimize Auxiliary Power Unit/Ground Power Unit use	Massport	Ongoing
Use of Ultra Low Sulfur Fuel in Massport fleet vehicles	Massport	Ongoing
Evaluation of the installation of a paved aircraft holding area at the head of Runway 23 to reduce minor aircraft delays	Massport	2014-2016
Continued consideration of Alternative Fuel Vehicles for any new Massport vehicle purchase	Massport	Ongoing
WATER QUALITY		
Support for Shawsheen Watershed Initiative to improve water quality and quantity flow in the Shawsheen River and its tributaries	Massport working with the MassDEP, USEPA, and Hanscom AFB	Ongoing
Stormwater improvements to construct detention areas around Hanscom in conjunction with the USAF	Massport through MassDEP grant	2014-2016
Continuation of MassDEP Best Management Practices	Massport	Ongoing
WILDLIFE		
Manage airfield in a manner that does not disrupt breeding season for grassland birds of which two species are listed under the Massachusetts Endangered	Massport	Ongoing

Species Act		
SUSTAINABLE DEVELOPMENT		
Implementation and maintenance of EMS procedures to control environmental effects	Massport	Ongoing

12.1 Current Massport Programs and Procedures

The 2012 *ESPR* describes the ongoing Massport programs and provides a comprehensive evaluation of the cumulative environmental effects of Hanscom Field. Massport has a number of programs in place to manage environmental issues at Hanscom Field. The environmentally beneficial measures for the 2020 and 2030 scenarios were identified within the context of these ongoing Massport programs and policies and are appropriate for the level of environmental effect that was identified in the technical analysis.

12.1.1 Environmental Programs

Massport has addressed many of the environmental issues that were identified in the 2005 *ESPR*, including working with the U.S. Environmental Protection Agency (EPA), Massachusetts Department of Environmental Protection (MassDEP), and the U.S. Air Force (USAF) to take actions to reduce impacts of Hanscom area activities on the Shawsheen River Watershed. Cooperatively, the agencies have assessed current impacts of stormwater through modeling of discharges in the drainage area, installing weirs to reduce peak flows, and removing impervious area and increasing infiltration. Massport has also implemented the following measures and monitoring programs to reduce or eliminate potential impacts to the environment at Hanscom Field:

- Tracking the progress of the Installation Restoration Program (for environmental cleanup) and the USAF's progress toward site closure as described in Chapter 9, Wetlands, Wildlife and Water Resources.
- Employing Best Management Practices through its EMS to reduce potential impacts on the environment.
- Performing regular visual inspections of water quality at Hanscom Field stormwater outfalls in accordance with its Stormwater Pollution Prevention Plan and the National Pollutant Discharge Elimination System (NPDES) permit.
- Enforcing Massport's policy that stormwater runoff for new projects does not increase peak runoff rates.
- Ongoing implementation of Hanscom Field's Spill Prevention Control and Countermeasure (SPCC) Plan to ensure that all of Massport's hazardous material storage tanks are in compliance with current regulations and to monitor the age, condition, and regulatory compliance status of these tanks on an ongoing basis through the Tank Management Program
- Employing pollution prevention measures as they apply to site drainage, material storage, material transfer, truck unloading operations, and site security as part of the SPCC Plan.
- Continuing efforts to minimize and prevent the future releases of hazardous materials through careful operation and maintenance of equipment and site activities; the availability of spill response equipment; periodic employee training, and monitoring and review of ongoing environmental/spill prevention programs; and an compliance with the regulatory requirements governing spill reporting and response actions.
- Ensuring that new development is designed to meet LEED Silver certification and Massport's Sustainable Design Standards and Guidelines.

12.1.2 Ground Transportation

Hanscom Field contributes a small percentage of traffic (four percent) to Route 2A traffic volumes. The 2012 peak hour volumes represent a slight decrease compared to the 2005 volumes reported in the *2005 ESPR*.

Massport is a MassRIDES partner. Massport is working with MassRIDES to develop an outreach program to make its employees and tenants aware of various MassRIDES programs such as the Emergency (Guaranteed) Ride Home Program for carpool and transit users. MassRIDES provided input to the employee and student survey that was discussed in Chapter 6, Ground Transportation.

Massport will continue to work with MassRIDES to review other potential TDM measures that would be appropriate for Hanscom Field. These would include measures (previously discussed in the *2005 ESPR*) such as updates to Massport's website and other mechanisms to distribute information.

12.1.3 Noise Abatement

Massport implements an aggressive noise abatement program at Hanscom Field. Massport restricts touch-and-go operations between 11:00 p.m. and 7:00 a.m., the most noise-sensitive time of day, and imposes a fee on other operations to discourage nighttime operations. The fee doubles for aircraft that conduct more than five night operations in a calendar year. This nighttime field use charge applies to all aircraft including commercial flights. Massport added enhancements to implement the Fly Friendly Program, which includes encouraging operators to use noise abatement procedures.

Tables 12-2 and 12-3 present metric and recommendations respectively prepared by the Hanscom Field Noise Workgroup report (using the same numbering methodology) which has guided the Noise Abatement. Nearly ninety percent of the recommendations have been implemented or are in the process of implementation. Eight of the fourteen measures were included in the *2005 ESPR* and updated in the *2012 ESPR*. Four other recommendations related to noise monitoring and the correlation of complaints with noise events are being addressed through updates to the Noise and Operations Monitoring System.

Massport continues to enhance its nighttime run-up noise abatement procedures. Massport directs operators to the run-up pad located due south of Runway 11-29 and west of the intersection with Runway 05-23 during the day. There is a short "blast fence" on the east side of the pad which deflects jet exhaust, prop wash, and debris. During nighttime hours, Massport directs operators to the east end of the East Ramp away from residential areas. Massport has as no plans to provide additional attenuation at these run-up areas. Massport also encourages Fixed Base Operators (FBOs) to minimize the use of auxiliary power units (APUs) and ground power units (GPUs) to minimize noise.

Table 12-2 Hanscom Noise Workgroup Metrics Recommendations

Number	Description	Status
M1	The workgroup should continue in existence and make additional suggestions for changes to the ESPR.	The Noise Workgroup contributed substantially to the formulation of the scope of work that formed the basis for the ongoing Hanscom Field ESPR analyses.
M2	The ESPR should include Time-Above (TA) contours and their areas.	Included. Figure 7-12, Figure 7-13 and Figure 7-19 to Figure 7-22 illustrate the contours and Table 7-16 and Table 7-30 present the estimated areas within the contours.
M3	The ESPR should show Single Event Level Distributions.	Included as Figure 7-16 and Figure 7-23.
M4	The next GEIR [ESPR] should include a linear dimensionless metric to show exposure to noise energy.	Not included. No such metric is used regularly in the evaluation of aircraft or other environmental noise.
M5	Future GEIRs (ESPRs) should include discussion of impacts with reference to the EPA level of 55 dB DNL and avoid the implication that DNL less than 65 (the Federal Aviation Administration mitigation threshold) has no impact.	Included in Chapter 7, Noise.
M6	Future GEIRs (ESPRs) should include three Community Summary Metrics - Loud Event Count, Area of 55 dB DNL contour, and Area of the 30-minute TA 55 dBA contour.	Included. Figure 7-16 and Figure 7-23 present SEL distributions; Table 7-9 and Table 7-24 present the estimated areas within the DNL contours; Table 7-11 and Table 7-25 present the population estimates within the current and forecasted 55 dB DNL contour; Figure 7-13, Figure 7-21 and Figure 7-22 present the area of the 30-minute TA 55 dBA contour.
M7	Documentation should include a detailed list of assumptions and model parameters used in the noise modeling.	Included in Chapter 7, Noise.
M8	The ESPR should include a section discussing the estimated variation in Integrated Noise Model (INM) results due to different modeling assumptions, and Massport should adopt the standard practice of reporting "error bands." The ESPR should also include a comparison of measured and modeled results and an explanation of the differences.	Not included. There is no current FAA guidance or industry best practices guidelines for such an analysis. However, the noise analyses in the ESPR are intended to evaluate the range of noise exposure due to existing and forecast fleet and airport development assumptions. Measured noise values are compared to modeled noise values for the six permanent noise monitors.
M9	Future ESPRs should explain expected short-term variations in noise from long-term averages.	Included in Chapter 7, Noise.
M10	The ESPR should document how changes in the INM data [base] affect predicted noise exposure.	Included in Chapter 7, Noise.
M11 and M12	Three of the six permanent noise monitoring sites should be relocated and more sites should be added to the system.	In process. Massport is working with the communities to relocate two of the six permanent noise monitoring sites.
M13 and M14	A procedure or system should be developed to correlate noise events with flight data and complaints, and the noise data should be stored in a publicly accessed location such as a web site.	Recent updates to the Noise and Operations Monitoring System are described in Section 7.8.4.

Table 12-3 Status of the Hanscom Noise Workgroup Noise Abatement Recommendations

Number	Measure	Detail	Massport Actions to Date
A1	Voluntary Noise Abatement Procedures	Massport will formalize, publish, distribute and post existing noise abatement procedures drafted by Massport, HART, and HPA.	Massport distributes handouts and posters describing noise abatement procedures to all tenants, fixed base operators, and flight training schools. Massport mailed AOPA Fly Friendly videos to all hangar and tie-down tenants. Additionally, Massport installed AOPA and NBAA noise abatement procedures in its badge training program. All based pilots are asked to watch the AOPA or NBAA video when getting or renewing a security badge.
A2	Distribution to	Massport will duplicate and deliver to flights	Massport distributes handouts and posters

Number	Measure	Detail	Massport Actions to Date
	Renters	schools voluntary noise abatement procedures in sufficient quantity for schools to distribute to all aircraft renters.	describing noise abatement procedures to all tenants, fixed based operators, and flight training schools.
A3	Informative Page Markers	Massport will print and distribute informative page markers for noise abatement information in Jeppesen and Flight guide handbooks to local and transient pilots.	Massport distributes flight manual inserts describing noise abatement procedures to all tenants, fixed base operators, and flight training schools.
A4	Flight School Briefings	Hanscom flight schools will display and distribute local noise abatement procedures to their pilots, brief all flight instructors at least annually on local noise abatement procedures and AOPA Fly Friendly program, and require all students to view the AOPA Fly Friendly video.	Massport discusses noise abatement with the flight schools and makes the AOPA Fly Friendly video available. Handouts are replenished. Flight school pilots and student pilots watch the AOPA video when getting or renewing a security badge.
A5	Flight Training Center Briefings	The Hanscom AFB Flight Training Center will display in its flight planning room, and distribute to its members local noise abatement procedures brief the AOPA Fly Friendly program and local noise abatement procedures at its safety meetings at least annually, and require new club members to view the AOPA Fly Friendly video.	Massport provided the Hanscom AFB Flight Training Center with posters, flight manual inserts, and AOPA Fly Friendly videos. Flight manual inserts continue to be made available.
A6	FBO Guest Follow-up	Each FBO at Hanscom will institute a guest sign-in sheet and send each transient pilot a follow-up letter describing the voluntary noise abatement procedures at Hanscom.	Massport works with FBOs to implement this measure. Massport makes inserts available which the FBOs display in their flight preparation rooms.
A7	Massport Website	Massport will include the voluntary noise abatement procedures for Hanscom on its public access website with mutual links to the USAF and other web-based pre-flight planning resources.	Massport's website includes the voluntary noise abatement procedures for Hanscom Field.
A8	ATIS Broadcast	The ATIS broadcast will include a reminder that voluntary noise abatement procedures are in effect and whenever workload permits the Tower, Ground, and Clearance Delivery will follow with reminders.	FAA is the primary entity responsible for implementing this measure.
A9	Hanscom AFB Leader Briefings	Hanscom AFB representatives to the Hanscom Noise Workgroup will brief Electronic Systems Center and 66th Air Base Wing leaders on local noise abatement procedures, sensitivities, and issues.	Massport is not the primary entity responsible for implementing this measure.
A10	Military Flight Crews	Hanscom AFB Transient Alert will display and distribute local noise abatement procedures and information to military flight crews utilizing their facility.	Massport is not the primary entity responsible for implementing this measure. Massport distributed handouts and posters describing noise abatement procedures and continues to make handouts available.
A11	ESC Web page	The Hanscom AFB Electronic Systems Center will create a web page dealing with noise abatement issues at Massport for both military and civilian pilots.	Massport is not the primary entity responsible for implementing this measure.
A12	ESC Press Releases	The Hanscom AFB Electronic Systems Center Office of Public Affairs will send area newspapers regular (biweekly or monthly) news releases updating area residents on Air Force flight operations, subject to security considerations.	Massport is not the primary entity responsible for implementing this measure.
A13	ESC Website News Releases	The Hanscom AFB Electronic Systems Center Office of Public Affairs will add information about Air Force flight operations to the public access section of the Hanscom AFB web site, subject to security considerations.	Massport is not the primary entity responsible for implementing this measure.
A14	AOPA Video Distribution	Massport will purchase and distribute the AOPA Fly Friendly video to all Hanscom pilots.	Massport distributed the video to all tenants, fixed based operators, and flight training schools. Pilots are encouraged to watch the AOPA or NBAA video when getting or renewing a security badge.

Number	Measure	Detail	Massport Actions to Date
A15	Hanscom User Group	Massport will provide support to ensure that a representative user group be available to all users, pilots, and businesses.	Massport is supportive of aviation user groups and encourages aviation participation at HFAC.
A16	Selectmen and Town Briefings	HNWG will brief Town Selectmen on the group's findings.	Massport is not the primary entity responsible for implementing this measure.
A17	Part 150 Study	A group representing local pilots, business interests, surrounding communities and Massport will be formed to investigate the possibility and implications of re-opening the Part 150 Study at Hanscom Field.	Massport is not the primary entity responsible for implementing this measure.
A18	Model Quiet Airport Study	A group representing local pilots, business interests, surrounding communities and Massport will be formed to define the scope and purpose of a Model Quiet Airport Study at Hanscom Field.	Massport is not the primary entity responsible for implementing this measure.
A19	Non-Profit Organization	A group representing local pilots, business interests, surrounding communities and Massport will be formed to explore the idea of establishing a non-profit organization to raise funds to support various noise reduction awareness programs.	Massport is not the primary entity responsible for implementing this measure.
A20	Noise Abatement Officer	A group representing local pilots, business interests, surrounding communities and Massport will be formed to explore the idea of establishing a Noise Abatement Officer position at Hanscom Field.	Massport has a Noise Abatement Coordinator who ensures continued distribution of noise abatement materials, talks to pilots, and responds to comments concerning noise. In addition, Massport's Office of Noise Abatement (at Logan) supports Hanscom's noise monitoring system.
A21	Noise Overlay Zones	A group including representatives of the Planning Boards of the towns of Lincoln, Lexington, Bedford, and Concord will be formed to study the issues associated with the creation of Noise Overlay Zoning Districts.	Massport is not the primary entity responsible for implementing this measure.
There are a number of recommendations for which Massport is not the primary entity responsible.			

Massport distributes handouts and posters describing noise abatement procedures to all tenants, FBOs, and flight training schools. Massport mailed AOPA Fly Friendly videos to all hangar and tie-down tenants. Additionally, Massport installs AOPA and NBAA noise abatement procedures in its badge training program. All based pilots are asked to watch the AOPA or NBAA video when getting or renewing a security badge.

Massport was an active participant in Sound Initiative, a coalition that successfully supported the federal phase out of Stage 2 aircraft weighing less than 75,000 pounds. Stage 2 aircraft were manufactured before today's stringent noise standards were adopted for new airplanes. The use of Stage 2 aircraft weighing over 75,000 pounds was phased out nationally by 2000, but most of Hanscom's jets weigh less than 75,000 pounds. In 2012, Congress passed the FAA Modernization and Reform Act, which included the phase out of all non-stage 3 aircraft by December 31, 2015. Section 506 of the Act prohibits the operation, within the 48 contiguous states, of jets weighing 75,000 pounds or less that do not comply with Stage 3 noise levels. Military aircraft are exempt from the Stage 3 Rule.

Massport has also launched the "Airport Activity Monitor" which allows the public to research a noise event or flight, log a noise disturbance, and track correspondence related to a noise disturbance.

12.1.4 Air Quality

Massport has also made progress in bringing alternative fuel vehicles (AFVs) into the fleet at Hanscom Field. Massport will continue to consider AFVs for any new vehicle purchase in the future. Also, since

Massachusetts has adopted the California LEV program, which requires that any new conventionally-fueled vehicle added to the Hanscom fleet in the future will have very low emissions and will automatically comply with the low emission goals of the federal Clean Fuel Fleet Program (40 CFR Part 88). As part of these regulations, ultra-low sulfur diesel fuel for on-road diesel vehicles was phased in starting in 2005. Massport also encourages FBOs to minimize the use of APUs and GPUs to address air quality considerations.

12.1.5 Project Development and Review

Massport will continue to provide regular updates on its activities at Hanscom Field through monthly HFAC meetings and the annual State of Hanscom reports. These public outreach and information mechanisms provide information to Bedford, Concord, Lexington, Lincoln, Hanscom AFB and the National Park Service on airport and project status. The *2012 ESCR* provides a comprehensive review of the cumulative environmental effects of Hanscom Field, but does not replace the requirement for an environmental filing for a specific project if that project meets or exceeds a MEPA regulatory threshold.

12.1.5.1 State and Local Review

Where state environmental review thresholds are exceeded, proposed projects are subject to a project-specific environmental review process with opportunities for public comment. In cases where the state environmental thresholds are triggered, Massport or the project proponent must prepare the appropriate environmental filing.

Massport is not subject to local zoning; however projects involving work within wetland resource areas or their buffer zones will involve applications to the appropriate conservation commissions for permitting as required under the Massachusetts Wetlands Protection Act. Massport will make every effort to avoid, minimize, and mitigate potential wetland impacts for future Massport or tenant projects.

12.1.5.2 Use of ESCR Baseline Data

Within this context, the *2012 ESCR* provides baseline conditions to inform the planning and review of future activities and projects at Hanscom Field including:

- A comprehensive database of historic and cultural resources including archeological sensitive locations located on Massport property
- Summary information and illustrations of the location of public water supplies and Zone II Wellhead Protection Areas
- Summary information and illustrations of wetlands resources, rare and endangered species, and agricultural resources at Hanscom Field
- Traffic volume data on area roadways and intersections

12.1.5.3 Massport Guidance

Massport guides the location of new facilities at Hanscom Field to developed areas where feasible to minimize impacts to undeveloped, natural areas. The continued implementation of the EMS at Hanscom Field also encourages the use of sustainable principles in future projects. Massport encourages the following specific measures for the development of new facilities:

- Achieving LEED Silver certification
- Use of Massport's Sustainable Design Guidelines

- If feasible, locating new water, sewer and stormwater drainage systems within already developed areas
- Implementing soil erosion and sediment control measures during construction
- Designing facilities that require septic systems in accordance with Title 5 regulations
- Using BMPs to ensure that relevant stormwater runoff rates are not increased both during construction and in future operating conditions

The construction of a new FBO facility by Rectrix Aviation is an example of a project designed and implemented using Massport's environmental and sustainable guidance. Since the facility is located in a Zone II Wellhead Protection Area that protects the recharge area around three public wells in Bedford, the new fueling facility is an above-ground fuel storage facility designed in accordance with the regulatory requirements of 527 CMR 9.00, "Board of Fire Prevention Regulations: Tanks and Containers" overseen by Massport's Fire Chief. The new facility was moved outside of the Zone II Wellhead Protection Area and adjacent to the existing fuel farm.

The 2012 *ESPR* identifies the potential environmental effects of the 2020 and 2030 scenarios. The continued implementation and planned enhancement of the existing programs and measures, such as continually expanding the EMS program, is expected to address many of the potential environmental effects of the 2020 and 2030 scenarios. Other environmentally beneficial measures would likely be developed if and as concepts move forward to become specific projects.

12.2 Additional Environmentally Beneficial Measures

12.2.1 Ground Transportation

Measures to address ground transportation considerations in the 2020 and 2030 scenarios focus on traffic management and TDM approaches, as well as planning efforts to facilitate the development of non-auto modes in the area.

12.2.1.1 Transportation Demand Management

TDM measures will provide appropriate environmentally beneficial measures if airport activity levels approach the 2020 and 2030 scenarios. Massport is a MassRIDES partner and has already begun efforts to develop TDM measures through the TMI program that MassRIDES administers for the Massachusetts Department of Transportation (MassDOT). Massport is also coordinating with the Hanscom AFB on TDM Programs and will be conducting a joint transportation fair at Hanscom to provide information and encourage registration with MassRIDES.

Massport interviewed its tenants in December 2012 and conducted a travel survey of airport employees and the National Aviation Academy (NAA) in August 2013. Based on discussions with MassRIDES and the information from the interviews, surveys and future outreach meetings with tenants, Massport will enhance its TDM program at Hanscom Field. This could include the distribution of travel information and evaluation of alternative modes.

12.2.1.2 Bicycle Facilities

As indicated in Chapter 6, Ground Transportation, Hanscom Field and its environs benefit from a network of regional bicycle facilities. However, some of the trails are not directly linked to the other regional trails. The Town of Concord has expressed interest in providing links between a rail-to-trail that the Town

of Bedford is considering and the existing network of paths in the MMNHP. Massport will work with the towns and the National Park Service to explore this option.

Massport is also evaluating the development of a bikeshare network that would provide bike facilities and rental bikes for use between Hanscom Field, the AFB, the town centers, and the MBTA commuter rail.

12.2.2 Noise

Massport will continue to support its Fly Friendly program and coordination with aircraft pilots and local stakeholders. Massport has been actively discussing changes to the noise monitoring system including possible relocation of noise monitors and upgrades to the operating system that will facilitate addressing additional recommendations identified by the Hanscom Noise Workgroup.

In all future scenarios, the total population exposed to high noise levels at Hanscom Field remains low and well below historic levels. In the 2020 and 2030 scenarios, none of the locations evaluated, including historical resources, are exposed to a DNL value over 60 dBA, 5 dBA below the federal standard for noise compatibility. Aircraft noise mitigation is being addressed by FAA's ongoing efforts to make aircraft quieter. Therefore, Massport does not propose site specific noise abatement to address conditions that are projected in the 2020 and 2030 scenarios, but instead plans to focus on implementation of its noise abatement regulations, procedures, and programs.

12.2.3 Air Quality

The air quality analysis in Chapter 8 indicates that the emission levels forecasted for the 2020 and 2030 scenarios will not result in any significant adverse air quality effects and will be below historic levels. However, Massport will continue its efforts to help to reduce emissions including TDM measures, encouraging FBOs to minimize the operation of APU's and GPU's, and efforts to bring AFV's into the fleet at Hanscom Field. Massport will also investigate the creation of an aircraft holding area at the head of Runway 23 that would allow piston aircraft to pull off Taxiway G and complete their pre-flight checkout, freeing other aircraft that are behind to takeoff.

12.2.4 Water Quality and Stormwater

Massport will encourage new facilities at Hanscom to be located in developed areas where feasible. The continued implementation of the EMS at Hanscom Field will also encourage the use of sustainable principles in future projects. All potential components of the 2020 and 2030 scenarios would be required to meet requirements of the NPDES Permit and applicable standards for stormwater management required by the MassDEP.

The 2012 *ESPR* identifies other potential development sites in the North Airfield area that fall within the Zone II Wellhead Protection Areas for the Bedford Town Wells. As specific projects are developed, including corporate GA hangars in the North Airfield, Massport will review the designs to ensure that appropriate measures are taken to protect the recharge area of the Bedford public wells.

Acronyms and Glossary of Terms

Acronyms and Abbreviations

This section provides a list of acronyms and abbreviations that are found in the *2012 ESPR*. The Glossary of Terms provides definitions for acronyms and abbreviations that have an asterisk (*).

µg/m³ micrograms of pollutant per cubic meter

A

ABW Air Base Wing
ADD* Average Daily Demand
ADF* Average Daily Flow
AFB* (Hanscom) Air Force Base
AFDSI Air Force Director of Staff Information
AFV* Alternative Fuel Vehicle
ALP* Airport Layout Plan
ALS* Approach Lighting System
AMSL Above mean sea level
ANRAD* Abbreviated Notice of Resource Area Delineation
APA American Planning Association
APU* Auxiliary Power Unit
ARFF Aircraft Rescue and Fire Fighting
ARP* Airport Reference Point
ARTC Anderson Regional Transportation Center
ARTS* Automated Radar Terminal System
ASR* Airport Surveillance Radar
ATC* Air route traffic control center
ATCT* Airport traffic control tower
ATR Automatic Traffic Recorder

B

BDL Bradley International, CT airport code
BED Hanscom Field, MA airport code

BGR Bangor, ME airport code
BLSF* Bordering Land Subject to Flooding
BMP* Best Management Practice
BOS (Logan) Boston, MA airport code
BRAC* Base Realignment and Closure
BVT Burlington, VT airport code
BVW* Bordering Vegetated Wetlands
BX Base Exchange

C

CEQ Council on Environmental Quality
CERCLA* Comprehensive Environmental Response, Compensation, and Liability Act
CMPL Concord Municipal Power and Light
CMR Commonwealth of Massachusetts Regulation
CMS* Congestion Management System
CO* Carbon monoxide
CPI Consumer Price Index
CTPS Central Transportation Planning Staff
CXC Chandra X-ray Center

D

dB* Decibel
dBA* A-weighted decibel
DCE* dichloroethylene
DEP Department of Environmental Protection
DERP* Defense Environmental Restoration Program
DNL* Day-Night Sound Level
DoD Department of Defense
DOT (U.S.) Department of Transportation

E

EA*	Environmental Assessment
EB	Eastbound
EDMS*	Emissions and Dispersion Modeling System
EIR*	Environmental Impact Report
EIS*	Environmental Impact Study
EMS*	Environmental Management System
ENF*	Environmental Notification Form
EOEA	Executive Office of Environmental Affairs
EOT	Executive Office of Transportation
EPA	(U.S.) Environmental Protection Agency
ESC	Electronic Systems Center
ESPR*	Environmental Status and Planning Report
EXP*	Total Noise Exposure

F

FAA	Federal Aviation Administration
FAEED*	FAA Aircraft Engine Emissions Database
FAF*	Final Approach Fix
FAP*	Final Approach Point
FAR	Federal Aviation Regulation
FBO*	Fixed Base Operator
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration Program
FICAN	Federal Interagency Committee on Aviation Noise
FICON	Federal Interagency Committee on Noise
FIR	Field Investigations Region
FIRM*	Flood Insurance Rate Map
FMVCP*	Federal Motor Vehicle Control
FONSI*	Finding of No Significant Impact

FY Fiscal Year

G

GA	General Aviation
GARA*	General Aviation Revitalization Act
GEIR*	Generic Environmental Impact Report
GIS	Geographic Information Systems
GMP*	General Management Plan
gpd	gallons per day
gpm	gallons per minute
GPU*	Ground Power Unit
GS*	Glide Slope
GSE*	Ground Service Equipment

H

HANAM	Hanscom Aboveground Tank – Massport
HANAT	Hanscom Aboveground Tank – Tenant
HANBM	Hanscom Underground Tank – Massport
HANBT	Hanscom Underground Tank – Tenant
HATS*	Hanscom Area Towns
HCM*	Highway Capacity Manual
HCS*	Highway Capacity Software
HFAC*	Hanscom Field Advisory Commission
HIRLS*	High Intensity Runway Lighting System
HNM*	Heliport Noise Model
HNWG*	Hanscom Noise Workgroup
HOV*	High Occupancy Vehicle
HP*	Horsepower
HUD	Department of Housing and Urban Development
HVN	Tweed New Haven, CT airport code
Hz*	Hertz

I-J

I/M Inspection & Maintenance
IFR* Instrument Flight Rule
ILS* Instrument Landing System
ILSF* Isolated Land Subject to Flooding
INM* Integrated Noise Model
IROD* Interim Record of Decision
IRP* Installation Restoration Program
ITE Institute of Transportation Engineers

K

kV* Kilovolt
kVA* Kilovolt ampere

L

LDA* Localizer Directional Aid; Landing Directional Aid
LEED* Leadership in Energy and Environmental Design
Leq* Equivalent Sound Level
LEV* Low Emissions Vehicle
LOC* Localizer antenna
LOS* Level of service
LSP* Licensed Site Professional
LTO* Landing and takeoff
LUWB* Land under Water Bodies/Waterways

M

M.G.L. Massachusetts General Law
MAC Massachusetts Aeronautics Commission
MACRIS* Massachusetts Cultural Resources Information System
MAGIC Minuteman Advisory Group on Interlocal Coordination
MALSR* Medium Intensity Approach Lighting System and Runway Alignment Indicator Lights
MAPC Metropolitan Area Planning Council

MassHighway Massachusetts Highway Department
MassPike Massachusetts Turnpike Authority
Massport Massachusetts Port Authority
MBTA Massachusetts Bay Transportation Authority
MCP* Massachusetts Contingency Plan
MDAR Massachusetts Department Agricultural Resources
MEPA* Massachusetts Environmental Policy Act
MESA* Massachusetts Endangered Species Act
MHC* Massachusetts Historic Commission
MHT Manchester-Boston, NH airport code
MIRLS* Medium Intensity Runway Lighting System
MIT Massachusetts Institute of Technology
MLS* Microwave Landing System
MMNHP* Minute Man National Historical Park
mph miles per hour
MPO Metropolitan Planning Organization
MWRAMassachusetts Water Resources Authority
MWRCMerrimack River Watershed Council

N

NAAQS* National Ambient Air Quality Standards
NASA National Aeronautics and Space Administration
NAVAID* Navigational Aid
NB Northbound
NCP* National Oil and Hazardous Substances Pollution Contingency Plan
NDB* Non-Directional Beacon

NEPA* National Environmental Policy Act of 1969
NERASP* New England Regional Aviation System Plan
NET National Emission Trends
NHESP* Natural Heritage and Endangered Species Program
NO₂* Nitrogen dioxide
NOI* Notices of Intent
NOMS* Noise and Operations Monitoring System
NO_x* Nitrogen oxides
NPC* Notice of Project Change
NPDES* National Pollutant Discharge Elimination System
NPL* National Priority List
NPS National Park Service
NR* National Register (of Historic Places)

O

O₃* Ozone
OFA* Object Free Area
OFZ* Object Free Zone
Opspecs Operations specifications
ORH Worcester, MA airport code
ORW* Outstanding Resource Water
OU* Operable Unit

P-Q

PAPI* Precision Approach Path Indicators
PAR* Precision Approach Radar
PCB* Polychlorinated biphenyl
PM* Particulate matter (e.g., PM₁₀, PM_{2.5})
PMT* Program for Mass Transit
ppm parts per million
psi pounds per square inch
PSM Portsmouth International, NH airport code
PVD T.F. Green, RI airport code

PWM Portland, ME airport code

R

RACT* Reasonably Available Control Technology
RAIL* Runway Alignment Indicator Lights
RAO* Response Action Outcome
RDA* Request for Determination of Applicability
REIL* Runway end identifier light
RIAC Rhode Island Airport Corporation
ROD* Record of Decision
RPZ* Runway Protection Zone
RSA* Runway Safety Area
RTAC Regional Transportation Advisory Council
RTCC Regional Transportation Coordinating Council
RTN Release Tracking Number
RVR* Runway visual range

S

SB Southbound
SDF* Simplified Direction Finding
SE* Single engine
SEL* Single Event Level
SIP* State Implementation Plan
SO₂* Sulfur dioxide
SPCCP* Spill Prevention Control and Countermeasure Plan
SR* State Register (of Historic Places)
SRS Strategic Reconnaissance Squadron
SSALR* Simplified Short Approach Light System (SSALR)
SuAsCo Sudbury-Assabet-Concord (Wild and Scenic River System)
SWPPP* Stormwater Pollution Prevention Plan
SX Assistant Secretary

T

TA* Time Above (a decibel threshold)
TACAN* Tactical Air Navigation
TCE* Trichloroethylene
TDM* Transportation Demand Management
TERPS* Terminal Instrument Procedures
TIM* Time-in-mode
TIP* Transportation Improvements Plan
TL* Taxilane
TMA* Transportation Management Association
TMI* Transportation Management Initiative
TPH* Total petroleum hydrocarbon
TRACON* Terminal Radar Approach Control
TRB Transportation Research Board
TSA* Transportation Security Administration: Taxiway Safety Area
TSS* Total suspended solids
TW* Taxiway

U

USACE U.S. Army Corps of Engineers
USC United States Code
USFWS U.S. Fish and Wildlife Service
USGS United States Geological Survey

V

VASI* Visual Approach Slope Indicators
VER* Vacuum-enhanced recovery
VFR* Visual Flight Rules
VMP* Vegetation Management Plan
VMT* Vehicle miles traveled
VOC* Volatile organic compounds
VOR* Very-High-Frequency Omnidirectional Range (aviation); Vehicle Occupancy Rate (ground transportation)

W-Y

WB Westbound
WPA* Wetlands Protection Act

Z

ZEV* Zero emissions vehicle

Glossary of Terms

A

A-Weighted Sound Level (dBA) – An adjustment to the very high and very low frequencies to approximate the human ear's reduced sensitivity to those frequencies. This adjustment is used to account for frequency dependence in measuring community noise. Customarily referred to simply as "sound levels," where the adjective "A-weighted" has been omitted. With A-weighting, a noise source having a higher sound level than another is generally perceived as louder. Also, the minimum change in sound level that people can detect outside of a laboratory environment is on the order of three decibels (dB). A change in sound level of ten dB is usually perceived by the average person as a doubling (or halving) of the sound's loudness, and this relationship holds true for loud sounds as well as for quieter sounds.

Average Daily Demand (ADD) – The calculated average of the sum of water meter readings for a facility or facilities.

Average Daily Flow (ADF) – A measure of wastewater flows that is typically described in gallons per day. Wastewater average daily flow is a calculation of the average wastewater flow generated from a facility based on 80 percent of the average daily potable water demand.

Abbreviated Notice of Resource Area Delineation (ANRAD) – The Abbreviated Notice of Resource Area Delineation, WPA Form 4A, is a filing to Conservation Commission of a local jurisdiction or the Massachusetts Department of Environmental Protection (DEP) that serves two purposes under the Massachusetts Wetlands Protection Act:

1. A procedure for an applicant to confirm the delineation of a Bordering Vegetated Wetland (BVW).
2. The application for Simplified Review for projects in the Buffer Zone, which must

certify that the project design meets all of the eligibility criteria in Section D of the ANRAD

If an ANRAD is filed for a BVW delineation, confirmation of other resource areas may also be requested provided the other resource area boundaries are identified on the plans which accompany the BVW boundary delineation. To determine the applicability of the Wetlands Protection Act, an applicants may file a Request for Determination of Applicability (RDA), a Notice of Intent (NOI) or an Abbreviated Notice of Intent. Any work within an area subject to the jurisdiction of the Wetlands Protection Act may not proceed until either a Negative Determination of Applicability or a final Order of Conditions has been issued by the Conservation Commission or DEP.

Air Route Traffic Control Center (ATC) – A facility established to provide air traffic control service to aircraft operating on Instrument Flight Rules (IFR) flight plans within controlled airspace and principally during the enroute phase of flight. When equipment capabilities and controller workload permit, certain advisory/assistance services may be provided to Visual Flight Rules (VFR) aircraft.

Air Taxi – An aircraft operator who conducts operations for hire or compensation in accordance with Federal Aviation Regulations (FAR) Part 135 in an aircraft with 30 or fewer passenger seats and a payload capacity of 7,500 lbs. or less. An air taxi operates on an on-demand or charter basis and cannot operate "scheduled" services with the same frequency as regional or commuter airlines. Air taxi operators are limited to no more than four scheduled roundtrip flights per route per week using turboprop aircraft.

Airport Traffic Control Tower (ATCT) – The air traffic control unit responsible for controlling movements around an airport as well as the

name of the building in which the unit operates. The height of permanent ATCT structures gives air traffic controllers visual contact with aircraft on the ground and in the air around an airport. The ATCT facility, operated by appropriate authority at an airport, promotes the safe, orderly and expeditious flow of air traffic within the airport traffic area.

Airport Elevation – The highest point of an airport’s usable runway expressed in feet above mean sea level (AMSL).

Airport Layout Plan (ALP) – A scaled drawing of existing and proposed land and facilities necessary for the operation and development of the airport.

Airport Lighting – Various lighting aids that may be installed on an airport. Types of airport lighting include:

1. **Approach Light System (ALS)** – An airport lighting facility which provides visual guidance to landing aircraft by radiating light beams in a directional pattern by which the pilot aligns the aircraft with the extended centerline of the runway on his final approach for landing. Condenser-Discharge Sequential Flashing Lights/Sequenced Flashing Lights may be installed in conjunction with the ALS at some airports. Types of ALS at the Airport are Simplified Short Approach Light System (SSALR) with Runway Alignment Indicator Lights (RAIL).
2. **Runway Lights/Runway Edge Lights** – Lights having a prescribed angle of emission used to define the lateral limits of a runway. Runway lights are uniformly spaced at intervals of approximately 200 feet, and the intensity may be controlled or preset.
3. **Runway Centerline Lighting** – Flush centerline lights spaced at 50-foot intervals beginning 75 feet of the opposite end of the runway.
4. **Runway End Identifier Lights (REIL)** – Two synchronized flashing lights, one on each side of the runway threshold, which provide rapid and positive identification of the approach end of a particular runway.
5. **Visual Approach Slope Indicator (VASI)** – An airport lighting facility providing vertical visual approach slope guidance to aircraft during approach to landing by radiating a directional pattern of high intensity red and white focused light beams which indicate to the pilot that he is “on path” if he sees red/white, “above path” if white/white, and “below path” if red/red. Some airports serving large aircraft have three-bar VASIs which provide two visual glide paths to the same runway.

Airport Marking Aids – Markings used on runway and taxiway surfaces to identify a specific runway, a runway threshold, a centerline, a hold line, etc. A runway should be marked in accordance with its present usage such as:

- Visual
- Nonprecision instrument
- Precision instrument

Airport Reference Point (ARP) – The latitude and longitude of the approximate center of the airport.

Airport Rotating Beacon – A visual NAVAID operated at many airports. At civil airports, alternating white and green flashed indicate the location of the airport. At military airports, the beacons flash alternatively white and green, but are differentiated from civil beacons by dualpeaked (two quick) white flashes between the green flashes.

Airport Surveillance Radar (ASR) – Approach control radar used to detect and display an aircraft’s position in the terminal area. ASR provides range and azimuth information but does not provide elevation data. Coverage of the

ASR can extend up to 60 miles, presenting air traffic controllers with the location of all aircraft within the range of the antenna.

Alternative Fuel Vehicle (AFV) – Vehicles that are powered by fuels that reduce the air pollution, solid waste, and hazardous waste that result from their use, service, and maintenance. Alternative fuels may include compressed natural gas, biodiesel, ethanol, electric and hybrid electric, propane, liquefied natural gas, and hydrogen fuel cells.

Approach Control Facility – A terminal Air Route Traffic Control Center facility that provides approach control service in a terminal area.

Approach Light System (ALS) – See Airport Lighting.

Apron – A defined area on an airport or heliport intended to accommodate aircraft for purposes of loading or unloading passengers or cargo, refueling, parking, or maintenance. With regard to seaplanes, a ramp is used for access to the apron from the water.

Automated Radar Terminal System (ARTS) – A range of systems that display for the terminal controller aircraft identification, flight plan data, other flight associated information such as altitude, speed, and aircraft position.

Auxiliary Power Unit (APU) – Self-contained generator on an aircraft that provides electricity, heat and air conditioning to an aircraft when its engines are off.

B

Banks – Land areas that normally abut and confine a water body. Banks occur between a waterbody and a vegetated wetland or adjacent floodplain, or between a waterbody and an upland.

Base Realignment and Closure (BRAC) – A process used by the U.S. Department of Defense to close military bases and realign assets to

improve efficiency and reduce cost. BRAC processes have occurred in 1989, 1991, 1993, 1995 and 2005.

Below Minimums – Weather conditions below the minimums prescribed by regulation for the particular action involved; e.g., landing minimums, takeoff minimums.

Best Management Practice (BMP) – Approaches to address the management of environmental resources in a proactive and practical fashion. Examples of BMPs include preventative maintenance, elimination of non-stormwater discharges to storm drains, spill response and the use of oil/water separators.

Bordering Land Subject to Flooding (BLSF) – The maximum lateral extent of floodwater, which will theoretically result from the statistical 100-year storm. The extent of Bordering Land Subject to Flooding is typically derived from examining FEMA Flood Insurance Rate Maps.

Bordering Vegetated Wetlands (BVW) – Vegetated areas that border on water bodies and waterways including vegetated freshwater wetlands. The technical criteria and methodology utilized to identify and delineate BVW is set forth in Delineating Bordering Vegetated Wetlands under the Massachusetts Wetlands Protection Act (DEP, 1995). Criteria for identifying and delineating this resource area include the presence of a plant community dominated by wetland indicator species, and signs of hydrology. The presence of hydric soils within the wetland is considered an indicator of hydrology.

C

Congestion Management System (CMS) – A federally mandated multimodal transportation plan for metropolitan areas. The findings of the CMS must be considered in the development of the Regional Transportation Plan and the Transportation Improvement Plan. Any

expansion of roadway capacity must be developed in the context of the CMS in transportation management areas that have not attained federal air quality standards. The Central Transportation Planning Staff prepares and updates the CMS for the Boston metropolitan area.

Carbon Monoxide (CO) – A regulated air pollutant created from the combustion of fossil fuel.

Ceiling – The heights above the earth’s surface of the lowest layer of clouds or obscuring phenomena that is reported as “broken,” “overcast,” or “obscuration,” and not classified as “thin” or “partial.”

Comprehensive Environmental Liability Act (CERCLA) – A federal law enacted by Congress on December 11, 1980 vehicle that provides federal authority to respond to releases or threatened releases of hazardous substances that may endanger public health or the environment. CERCLA established prohibitions and requirements concerning closed and abandoned hazardous waste sites; provided for liability of persons responsible for releases of hazardous waste at these sites; and, established a trust fund to provide for cleanup when no responsible party could be identified. The trust fund is funded by taxes on the chemical and petroleum industries.

Controlled Airspace – Airspace designated as a control zone, airport radar service area, terminal control area, transition area, control area, continental control area, and positive control area within which some or all aircraft may be subject to air traffic control.

D

Decibel (dB) – A logarithmic unit that is used to represent the intensity of sound. This representation is called a sound pressure level. A sound pressure level of less than 10 dB is

approximately the threshold of human hearing and is barely audible under extremely quiet conditions. Normal conversational speech has a sound pressure level of approximately 60 to 65 dB. Sound pressure levels above 120 dB begin to be felt inside the human ear as discomfort and eventually pain at still higher levels.

Decision Height – With respect to the operation of aircraft, means the height at which a decision must be made during an Instrument Landing System or instrument approach to either continue the approach or to execute a missed approach.

Departure Control – A function of an approach control facility providing air traffic control service for departing IFR and, under certain conditions, Visual Flight Rules aircraft.

Defense Environmental Restoration Program (DERP) – A program established by the Department of Defense to address hazardous substances, pollutants, contaminants, and military munitions remaining from past activities at military installations and formerly used defense sites.

E

Emissions and Dispersion Modeling System (EDMS) – Computer program established by the Federal Aviation Administration (FAA) to calculate emissions and dispersion of aircraft operations at an airport. The latest version is 4.3.

Enroute Air Traffic Control Services – Air traffic control service provided aircraft on Instrument Flight Rules flight plans, generally by centers, when these aircraft are operating between departure and destination terminal areas. When equipment, capabilities, and controller work load permit, certain advisory/assistance services may be provided to VFR aircraft.

Environmental Assessment (EA) – An environmental document filed in accordance

with the National Environmental Policy Act of 1969 that documents the environmental impacts of a proposed action in support of a Finding of No Significant Impact (FONSI) or the facilitation of the preparation of an Environmental Impact Statement (EIS). An EA and its FONSI document NEPA compliance. The EA process includes public review and comment on its scope and filing.

Environmental Impact Report (EIR) – An environmental document filed in accordance with the Massachusetts Environmental Policy Act, M.G.L. c. 30, sections 61 through 62H, inclusive, to study the environmental consequences of a project. Typically, the proponent files a draft and final EIR, but the Secretary of Environmental Affairs may allow a single EIR. The EIR process includes public review and comment on its scope and filings, which are noticed in the Environmental Monitor. At the close of the EIR review period, the Secretary decides whether the EIR is adequate and issues an Adequacy determination that includes enforceable mitigation commitments.

Environmental Impact Study (EIS) – An environmental document filed in accordance with the National Environmental Policy Act of 1969 that documents the environmental impacts of a proposed action that has significant environmental impacts. An EIS describes a proposed action, its purpose and need, alternatives to the proposed action, the affected environment, and an environmental analysis of each alternative. The EIS process includes public review and comment on its scope and filing.

Environmental Management System (EMS) – A system instituted by Massport to help evaluate and mitigate the environmental impacts from airport operations and planning.

Environmental Notification Form (ENF) – An environmental document filed in accordance with the Massachusetts Environmental Policy Act, M.G.L. c. 30, sections 61 through 62H,

inclusive, to begin the MEPA review process. A proponent begins the ENF process if a project is subject to MEPA jurisdiction and either it meets or exceeds one or more review thresholds or the Secretary of Environmental Affairs requires fail-safe review. The ENF process includes public review and comment on its scope and filing, which are noticed in the Environmental Monitor, and a MEPA Consultation session. At the close of the review period for an ENF, the Secretary issues an Adequacy Determination that may require an EIR or allow the proponent to take action on the project.

Environmental Status and Planning Report (ESPR) – An environmental filing made by Massport to the Executive Office of Environmental Affairs. An ESPR provides a retrospective analysis of past trends in the environmental effects of the airport while including analyses for future conditions under various scenarios. Massport prepares ESPRs for Hanscom Field and Logan Airport. The Hanscom Field ESPR is filed every five years.

Equivalent Sound Level (Leq) – A measure of exposure resulting from the accumulation of A-weighted sound levels over a particular period (as opposed to an event) of interest such as an hour, an eight-hour school day, nighttime, a single 24-hour period, or an average 24-hour period. Because the length of the period can differ, the applicable period should always be identified or clearly understood when discussing the metric. Such durations are often identified through a subscript, for example Leq (8) or Leq (24). Conceptually, the Leq may be thought of as the constant sound level occurring over the designated period of interest and having as much sound energy as that created by the actual rising and falling sound pressures from multiple noise sources as they become more or less pronounced.

F

FAA Aircraft Engine Emissions Database

(FAEED) – A computerized emissions inventory calculation procedure that contains air pollution emissions information for various aircraft engines and data correlating engines to specific aircraft. The emissions data from FAEED have been incorporated into the EDMS.

Federal Motor Vehicle Control Program

(FMVCP) – Air pollution emission standards for new motor vehicles that have been established by the U. S. EPA. These standards have mandated increasing strict air pollution emission factors for motor vehicles.

Final Approach – That part of an instrument approach procedure which commences at the specified final approach fix or point, or where such a fix or point is not specified,

1. at the end of the last procedure turn, base turn or inbound turn of a racetrack procedure, if specified; or
2. at the point of interception of the last track specified in the approach procedure; and ends at a point in the vicinity of an aerodrome from which: a) a landing can be made; or b) a missed approach procedure is initiated.

Final Approach Fix (FAF) – The fix from which the final approach (IFR) to an airport is executed and which identifies the beginning of the final approach segment. When ATC directs a lower-than-published Glide Slope/path Intercept Altitude, it is the resultant actual point of the glide slope/path intercept.

Final Approach Point (FAP) – The point, applicable only to a nonprecision approach with on depicted Final Approach Fix such as on-airport Very-High-Frequency OmniRange (VOR), where the aircraft is established inbound on the final approach course from the procedure turn and where the final approach descent may be commenced. The FAP serves as the FAF and

identifies the beginning of the final approach segment.

Fixed Base Operator (FBO) – A full-service FBO is a company that handles a range of needs for based and transient aircraft, their operators, and their passengers. These include cleaning, maintaining, fueling and parking/hangaring aircraft, providing flight planning services for the pilots, and arranging for the specific needs of those flying such as ground transportation or overnight accommodations. Although the majority of FBO activity involves servicing corporate general aviation activity, the FBOs also provide some charter activity.

Flood Insurance Rate Map (FIRM) – A map that are published by the Federal Emergency Management Agency to determine flood insurance requirements and to assist communities in regulating new development. Flood Insurance Rate Maps show areas that have a one percent chance of flooding (the 100-year floodplain) and a 0.2 percent chance of flooding in any given year (the 500-year floodplain). These areas are determined to be the areas of highest risk when a stream overflows its banks or when coastal waters experience tidal surges from tropical storms or hurricanes.

G

General Aviation (GA) – That portion of civil aviation which encompasses all facets of aviation except air carriers holding a certificate of public convenience and necessity from the Civil Aeronautics Board and large aircraft commercial operators.

General Aviation Revitalization Act (GARA)

– Legislation that amends the Federal Aviation Act of 1958 to establish time limitations on certain civil actions against aircraft manufacturers.

General Management Plan (GMP) – Broad and comprehensive, long-term planning

documents prepared by National Park Service for each National Park, which typically encompasses preservation of natural and cultural resources, visitor use and interpretation, roads, and facilities.

Generic Environmental Impact Report

(GEIR) – An environmental filing to the Executive Office of Environmental Affairs that assesses the environmental effects of policies or plans as opposed to site-specific projects.

Glide Slope (GS) – Provides vertical guidance for aircraft during approach and landing. The glidescope/glidepath is based on the following:

- Electronic components emitting signals which provide vertical guidance by reference to airborne instruments during instrument approaches such as Instrument Landing System/, or
- Visual ground aids which provide vertical guidance for Visual Flight Rules approach or for the visual portion of an instrument approach and landing.

Ground Power Unit (APU) – Generator on the ground that provides electricity, heat and air conditioning to an aircraft when its engines are off.

H

Hanscom Air Force Base (AFB) – 396-acre United States Air Force Base in Bedford, Concord, Lexington, and Lincoln that supports the Electronic Systems Center of the Air Force Material Command.

Hanscom Area Towns (HATS) – The Growth and Development Policy Committee established under M.G.L. Chapter 40 Section 4I to address intergovernmental and planning issues in Bedford, Concord, Lexington and Lincoln.

Hanscom Field Advisory Commission

(HFAC) – An advisory commission that was established by act of the State legislature in 1980. HFAC includes 16 members appointed by the selectmen of Bedford, Concord, Lexington

and Lincoln. HFAC includes representatives from the Town of Bedford, Concord, Lexington and Lincoln; local citizens groups; other area towns affected by Hanscom Field; businesses basing aircraft at Hanscom Field; aviation or aviation-related businesses at Hanscom Field; and business-aviation general aviation organizations. HFAC and Massport meet monthly to provide continued communication.

Hanscom Noise Workgroup (HNWG) – A group of community- and aviation-based members that was organized by Massport at the request of the Secretary of Environmental Affairs after the filing of the 1995 GEIR in 1997. The HNWG met for a period of two years and published its findings in a report entitled "Report of the Hanscom Field Noise Workgroup," dated September 22, 1999. Their report summarizes the series of meetings by the committee and its two task groups, one devoted to abatement and mitigation, the other to metrics and modeling.

Hertz (Hz) – International System of Units measure for the number of times that a repeated event occurs during a specified unit of time

Heliport Noise Model (HNM) – A computer program that is intended to serve as an aid in assessing the impact of helicopter noise in the vicinity of terminal operations. HNM Version 2.2 is based upon Version 4 of the Federal Aviation Administration's Integrated Noise Model (INM). Utilized in the 2005 ESPR as a data source for helicopter flight profiles

High Occupancy Vehicle (HOV) – A vehicle carrying two or more passengers.

High Intensity Runway Lighting System

(HIRLS) – A system of high intensity lights that outline edges of runways during periods of darkness or restricted visibility conditions.

Horsepower (HP) – A measure of power. The electrical industry defines the horsepower of electric motors to be 746 watts at 100-percent efficiency.

I

Initial Approach Fix – The fixes depicted on instrument approach procedure charts that identify the beginning of the initial approach segments.

Installation Restoration Program (IRP) – A program within the DERP that focuses on releases of hazardous substances, pollutants, or contaminants that pose environmental health and safety risks.

Instrument Approach Procedure – A series of predetermined maneuvers for the orderly transfer of an aircraft under instrument flight conditions from the beginning of the initial approach to a landing or to a point from which a landing may be made visually. It is prescribed and approved for a specific airport by competent authority.

Instrument Flight Rules (IFR) – Rules governing the procedures for conducting instrument flight. Also a term used by pilots and controllers to indicate type of flight plan.

Instrument Landing System (ILS) – A precision instrument approach system which normally consists of the following electronic components and visual aids:

- Localizer
- Glide slope
- Outer Marker
- Middle Marker
- Approach Lights

Instrument Landing System (ILS) Category – An Instrument Landing System approach procedure which provides for approach to a height above touchdown of not less than 200 feet and with runway visual range of not less than 1,800 feet.

Instrument Meteorological Conditions – Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling less

than the minima specified for visual meteorological conditions.

Instrument Runway – A runway equipped with electronic and visual navigation aids for which a precision or nonprecision approach having straight-in landing minimums has been approved.

Integrated Noise Model (INM) – A complex computer program that calculates aircraft noise levels around an airport from user input data and an extensive internal database of aircraft noise and performance statistics. Outputs can include DNL contours and other metrics such as Time Above and DNL values at specific points. The FAA developed the INM as the primary tool for analyzing and evaluating noise impacts from aircraft operations. Its use is prescribed for all FAA-sponsored projects requiring environmental evaluation.

Interim Record of Decision (IROD) – An interim document in the progression of assessment and cleanup of a site, and is intended to provide the public with a consolidated source of information about the site history, characteristics, risks posed, and a rationale behind the selected remedy.

Inventory of the Historic and Archaeological Assets of the Commonwealth – Inventory of historic properties and archaeological sites maintained by the Massachusetts Historical Commission.

Isolated Land Subject to Flooding (ILSF) – Isolated depressions or closed basins without an inlet or outlet. It is an area which, at least once per year, confines standing water to a volume of at least one-quarter acre-feet and an average depth of at least six inches.

K

Kilovolt (kV) – A unit of measure equal to 1,000 volts that is commonly used to describe

the potential power of an electrical distribution system.

Kilovolt ampere (kVA) – A unit of measure equal to 1,000 volt amperes that is commonly used to describe the capacity of an electrical transformer.

L

L.G. Hanscom Field (Hanscom Field) – Approximately 1,300-acre civilian airport in Bedford, Concord, Lexington, and Lincoln and operated by the Massachusetts Port Authority.

Landing Minimums – The minimum visibility prescribed for landing a civil aircraft while using an instrument approach procedure. Descent below the established or Decision Height is not authorized during an approach unless the aircraft is in a position from which a normal approach to the runway of intended landing can be made and adequate visual reference to required visual cues is maintained.

Land Under Water Bodies/Waterways (LUWB) – The land area under any creek, river, stream, pond or lake is a resource area subject to protection under the Massachusetts Wetlands Protection Act.

Landing-Takeoff Cycle (LTO) – Aircraft operations performed at airports. The Landing-Takeoff Cycle includes: approach from a level of 3,000 feet above ground level, landing, taxi-in, taxi-out, takeoff, and climbout to a height of 3,000 feet above ground level.

Large Airplane – An airplane of more than 12,500 pounds (5,700 kg) maximum certificated takeoff weight.

Leadership in Energy and Environmental Design (LEED) – The U.S. Green Building Council established the LEED Green Building Rating System® as a “voluntary, consensus-based national standard for developing high-performance, sustainable buildings.” A rating system is used to determine four levels of LEED

certification with Platinum being the highest level.

Level of Service (LOS) – Level of service is a term used to describe the quality of the traffic flow on a roadway facility at a particular point in time. It is an aggregate measure of travel delay, travel speed, congestion, driver discomfort, convenience, and safety based on a comparison of roadway system capacity to roadway system travel demand. Operating level of service is reported on a scale of A to F, with A representing the best operating conditions and F representing the worst operating conditions. LOS A represents uncongested conditions with little or no delay to motorists, while LOS F represents a forced-flow condition with delays and traffic demands that have been identified as exceeding roadway capacity. Roadway operating levels of service are calculated following procedures defined in the *2000 Highway Capacity Manual (HCM)*, published by the Transportation Research Board (TRB) for signalized and unsignalized intersections

Licensed Site Professional (LSP) – The Massachusetts (DEP has developed a licensing procedure for consultants working in the context of the MCP, consisting of testing and training requirements to assure a base level of competency. Those consultants meeting DEP requirements become LSPs and provide assistance to disposal site owners to assure the site is cleaned up following the MCP process. The LSP minimizes DEP involvement in site activities by overseeing actions conducted at the site.

Localizer (LOC) – The component of an ILS that provides course guidance to the runway, emitting a signal used to establish and maintain an aircraft’s horizontal position until visual contact confirms the runway alignment and location.

Localizer Type Directional Aid (LDA) – A navigational aid used for nonprecision instrument approaches with utility and accuracy

comparable to a localizer but which is not a part of a complete ILS and is not aligned with the runway.)

Low Emissions Vehicle (LEV) – Motor vehicles that meet air pollution emission standards that are more-strict (lower) than those that are required for vehicles under the FMVCP.

M

Massachusetts and National Ambient Air Quality Standards (NAAQS) – Air pollutant concentrations for defined periods of time (1-hour, 24-hours, annual, etc.) established to protect the public's health and welfare in ambient (outdoor) air.

Massachusetts Contingency Plan (MCP) – A regulatory framework for cleaning up hazardous waste sites in Massachusetts. The MCP outlines the schedule and procedures to be followed at disposal sites to undertake necessary and appropriate response actions to provide protection of health, safety, public welfare and the environment. The MCP regulatory citation is 310 CMR 40.0000.

Massachusetts Cultural Resources Information System (MACRIS) – A computerized database listing of the Inventory of the Historic and Archaeological Assets of the Commonwealth that can be linked to MassGIS. MACRIS is maintained by the Massachusetts Historical Commission (MHC).

The Massachusetts Endangered Species Act (MESA) – The Massachusetts Endangered Species Act that was enacted in December 1990 to protect plant and animal species in danger of extinction. Implementing regulations were promulgated in 1992 and recently revised and implemented as of July 1, 2005. The regulation requires habitat alteration permits for projects that may alter a significant portion of habitat. The recent revisions clarify filing requirements,

implement fees, and specify time lines for the regulatory review process.

Massachusetts Environmental Policy Act (MEPA) – The Massachusetts Environmental Policy Act, M.G.L. c. 30, sections 61 through 62H, inclusive. The Massachusetts Environmental Policy Act requires that state agencies study the environmental consequences of their actions, including permitting and financial assistance. It also requires them to take all feasible measures to avoid, minimize, and mitigate damage to the environment. MEPA further requires that state agencies "use all practicable means and measures to minimize damage to the environment," by studying alternatives to the proposed project, and developing enforceable mitigation commitments, which will become permit conditions for the project if and when it is permitted.

Massachusetts Environmental Policy Act (MEPA) Office – The MEPA Office is the staff of the Secretary of Environmental Affairs responsible for daily implementation and administration of the MEPA review process. The staff, headed by the Assistant Secretary for Environmental Impact Review (also known as the MEPA Director), consists of environmental analysts and administrative support persons. The MEPA Office reviews ENF, EIR, Notice of Project Change (NPC), and ESPR filings; makes recommendations to the Secretary regarding the adequacy of these filings and the need for additional filings; assists project proponents, agencies, and the public with questions; interprets the MEPA regulations; publishes the Environmental Monitor and review schedule.

Massachusetts Historical Commission (MHC) – Established in 1983 to encourage preservation of the rich cultural heritage of the Commonwealth's cities and towns. The MHC is the State Historic Preservation Office.

Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights

(MALSR) – A configuration of medium-intensity lights with Runway Alignment Indicator Lights positioned symmetrically along the extended runway centerline to provide visual lighting guidance for landing aircraft. A MALSR supports Category I precision approaches.

Medium Intensity Runway Lighting System (MIRLS) – A system of medium intensity lights that define the lateral limits of runways during periods of darkness or restricted visibility conditions.

Microwave Landing System (MLS) – A precision instrument approach system operating in the microwave spectrum that provides the pilot of a properly equipped aircraft with electronic guidance to control the aircraft's alignment and descent until visual contact is made with the runway environment.

Middle Marker – A marker beacon that defines a point along the glide slope of an Instrument Landing System normally spaced at or near the point of decision height (Instrument Landing System Category I). It is keyed to transmit alternate dots and dashes, with the alternate dots and dashes keyed at the rate of 95 dot/dash combinations per minute on a 1300 Hz tone, which is received aurally and visually by compatible airborne equipment.

Minimums – Weather condition requirements established for a particular operation or type of operation; e.g., IFR takeoff or landing, alternate airport for Instrument Flight Rules flight plans, Visual Flight Rules flight, etc.

Minute Man National Historical Park (MMNHP) – The National Park Service operates the Minute Man National Historical Park, which was created in 1959. The park consists of three discontinuous sections referred to as the Battle Road, Wayside, and North Bridge Units and covers approximately 967

acres along Route 2A in Concord, Lexington, and Lincoln and off Monument Street in Concord. Minute Man National Historical Park itself and a number of individual historic properties within the park are historic resources of national significance that are designated National Historic Landmarks. The park is nationally significant as the site of the Battle of Concord, one of the two battles that marked the beginning of the Revolutionary War; for its association with prominent literary figures of the nineteenth and twentieth centuries; and as one of the earliest places in the nation to be commemorated. The park was created to " . . . provide . . . for the preservation and interpretation of historic sites, structures, and properties lying along the entire route of battle" in April 1775.

MOBILE6.2 – U. S. Environmental Protection Agency model to predict fleet-average emissions of carbon monoxide, oxides of nitrogen, and volatile organic compounds from motor vehicles.

Movement Area – The runways, taxiways, and other areas of an airport/heliport which are utilized for taxiing/hover taxiing, air taxiing, takeoff, and landing of aircraft, exclusive of loading ramps and parking areas. At those airports/heliports with a tower, specific approval for entry onto the movement area must be obtained from Air Route Traffic Control Center.

N

National Ambient Air Quality Standards

(NAAQS) – Air pollution concentrations in outdoor air that have been established by the EPA to protect the public's health and welfare. NAAQS are air pollution concentrations that may not be exceeded.

National Environmental Policy Act (NEPA)

of 1969 – An Act that established the national policy for the environment and created the Council on Environmental Quality. NEPA requires that an environmental impact statement

or EIS be prepared on every "major federal action" undertaken or permitted. A Finding of No Significant Impact (FONSI) is issued if it is determined that the project will not have a significant effect on the environment. An EIS must consider alternatives and mitigation measures that would lessen the project's impacts. The EIS must be made available in draft form for public comment and the agency must respond to those comments received in the Final EIS.

Natural Heritage and Endangered Species Program (NHESP) – Part of the Massachusetts Division of Fisheries and Wildlife that is responsible for the conservation and protection of hundreds of species that are not hunted, fished, trapped, or commercially harvested in the state. The highest priority of NHESP is protecting the approximately 190 species of vertebrate and invertebrate animals and 258 species of native plants that are officially listed as Endangered, Threatened or of Special Concern in Massachusetts. A primary responsibility of the NHESP is the regulatory protection of rare species and their habitats as codified under the MESA (M.G.L. c.131A) and Wetlands Protection Act (M.G.L c.131s.40).

National Oil and Hazardous Substances Pollution Contingency Plan (NCP) – The NCP establishes an organizational structure and procedures for preparing for and responding to discharges of oil and releases of hazardous substances, pollutants, and contaminants. Development of the NCP was required under the Comprehensive Environmental Liability Act (CERCLA), also known as the Superfund Act, and by the U.S. Clean Water Act.

National Pollutant Discharge Elimination System (NPDES) – A program authorized under the U.S. Clean Water Act to control water pollution by regulating point sources (e.g., pipes, ditches, conduits) that discharge pollutants into waters of the United States. NPDES permits are

administered by U.S. EPA or delegated to individual states to administer. General and Individual NPDES permits are typically five years in length and have provisions for automatic extensions if the permit is not reissued prior to expiration.

National Priority List (NPL) – List of hazardous waste sites eligible for long-term remedial action financed under the federal Superfund program.

National Register of Historic Places (NR) – Includes properties of local, state, and national significance designated by the Department of the Interior through the State Historic Preservation Officer.

Navigational Aid (NAVAID) – Any visual or electronic device airborne or on the surface which provides point-to-point guidance information or position data to aircraft in flight.

New England Regional Aviation System Plan (NERASP) – A joint effort by the FAA, Massport and the Massachusetts Aeronautics Commission with the involvement of major commercial service airports throughout the six-state region. The NERASP developed forecasts from a regional perspective rather than from the perspective of an individual airport or a state system of airports. Each airport's potential to accommodate scheduled commercial passenger was based not only on the demand generated by the airport's catchment area, but also considered the attractiveness of nearby airports that passengers may also utilize

Nitrogen dioxide (NO₂) – One of the Oxides of Nitrogen (NO_x) compounds. The U. S. EPA has established regulations, including a NAAQS, for nitrogen dioxide (NO₂).

Noise and Operations Monitoring System (NOMS) – A system of six permanent noise monitors near Hanscom Field and the software that is used to monitor their operation. The

system was installed in 1989 and is in the process of being upgraded by Massport.

Noise Sensitive Receptor – Site-specific location where noise exposure may be a concern. The ESPR calculates DNL and Time Above values at the following types of noise sensitive receptors: hospitals, sites on the National Register of Historic Places, public facilities, religious sites, and schools.

Nondirectional Beacon (NDB) – A Low/Medium Frequency or Ultra High Frequency radio beacon transmitting nondirectional signals whereby the pilot of an aircraft equipped with direction finding equipment can determine his bearing to or from the radio beacon and “home” on or track to or from the station. When the radio beacon is installed in conjunction with the Instrument Landing System marker, it is normally called a Compass Locator.

Nonmovement Area – Taxiways and apron (ramp) areas not under the control of air traffic.

Nonprecision Approach Procedure – A standard instrument approach procedure in which no electronic glidescope is provided; e.g., VHF Omnidirectional Range (VOR), Tactical Aircraft Control and Navigation (TACAN), NDB, LOC, ASR, LDA, or Simplified Direction Finding (SDF) approaches.

Notice of Intent (NOI) – A filing with the Conservation Commission of a local jurisdiction that uses WPA Form 3 or, in limited circumstances WPA Form 4 (Abbreviated Notice of Intent), to seek confirmation of delineated wetland resource area boundaries

Notice of Project Change (NPC) – An environmental document filed in accordance with the Massachusetts Environmental Policy Act, M.G.L. c. 30, sections 61 through 62H, inclusive, if there is any material change in a project prior to the taking of all Agency Actions for the project. The continuation of the project by a new proponent shall not by itself constitute

a change in the Project, provided that the new proponent adopts all mitigation measures to which the previous Proponent committed. The NPC shall specify in detail any change in the information provided in any previous review document. In determining whether a change in a project or the lapse of time might significantly increase environmental consequences, the Secretary shall consider the following factors:

a) Expansion of the Project. A change in a project is ordinarily insignificant if it results solely in an increase in square footage, linear footage, height, depth or other relevant measures of the physical dimensions of the project of less than ten percent over estimates previously reviewed, provided the increase does not meet or exceed any review thresholds.

b) Generation of further impacts, including an increase in release or emission of pollutants or contaminants during or after completion of the project. A change in a project is ordinarily insignificant if it results solely in an increase in impacts of less than twenty-five percent of the level specified in any review threshold, provided that cumulative impacts of the project do not meet or exceed any review thresholds that were not previously met or exceeded.

c) Change in expected date for commencement of the project, commencement of construction, completion date for the project, or schedule of work on the project.

d) Change of the project site.

e) New application for a permit or new request for financial assistance or a land transfer.

f) For a project with net benefits to environmental quality and resources or public health, any change that prevents or materially delays realization of such benefits.

g) For a project involving a lapse of time, changes in the ambient environment or information concerning the ambient environment.

O

Object – Includes, but is not limited to, above ground structures, NAVAIDs, people, equipment vehicles, natural growth, terrain, and parked aircraft.

Object Free Area (OFA) – An area on the ground centered on a runway, taxiway, or taxilane centerline provided to enhance the safety of aircraft operations by having the area free of objects, except for objects that need to be located in the OFA for air navigation or aircraft ground maneuvering purposes.

Obstacle – An existing object, object of natural growth, or terrain at a fixed geographical location or which may be expected at a fixed location within a prescribed area with reference to which vertical clearance is or must be provided during flight operations.

Obstacle Free Zone (OFZ) – The OFZ is the airspace below 150 feet (45 m) above the established airport elevation and along the runway and extended runway centerline that is required to be clear of all objects, except for frangible visual NAVAIDs that need to be located in the OFZ because of their function, in order to provide clearance protection for aircraft landing or taking off from the runway, and for missed approaches. The OFZ is subdivided as follows:

- **Runway OFZ** – The airspace above a surface centered on the runway centerline;
- **Precision Approach Category I (CAT I) Runway** – A runway with an instrument approach procedure which provides for approaches to a decision height (DH) of not less than 200 feet (60m);
- **Runway Protection Zone (RPZ)** – An area off the runway end to enhance the protection of people and property on the ground;

- **Runway Safety Area (RSA)** – A defined surface surrounding the runway prepared or suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the runway;
- **Shoulder** – An area adjacent to the edge of paved runways, taxiways or aprons providing a transition between the pavement and the adjacent surface; support for aircraft running off the pavement; enhanced drainage; and blast protection;
- **Taxilane (TL)** – The portion of the aircraft parking area used for access between taxiways and aircraft parking positions;
- **Taxiway (TW)** – A defined path established for the taxiing of aircraft from one part of an airport to another;
- **Taxiway Safety Area (TSA)** – A defined surface alongside the taxiway prepared or suitable for reducing the risk of damage to an airplane unintentionally departing the taxiway;
- **Visual Runway** – A runway without an existing or planned straight-in instrument approach procedure.

The OFZ is a three dimensional volume of airspace which protects for the transition of aircraft to and from the runway. The OFZ clearing standard precludes taxiing and parked airplanes and object penetrations, except for frangible NAVAID locations that are fixed by function. Additionally, vehicles, equipment, and personnel may be authorized by air traffic control to enter the area using the provisions of Order 7110.656, Air Traffic Control, paragraph 3-5. The runway OFZ and, when applicable, the inner-approach OFZ and the inner-transitional OFZ, comprise the OFZ.

Operable Unit (OU) – A discreet portion of a site that is investigated and cleaned up

separately from other portions of the site. Dividing a site into two or more operable units allows separate investigations and cleanups to proceed at their own pace. Common examples are investigating soil and groundwater contamination separately, and cleaning up and redeveloping small portions of a larger site.

Outer Marker – A marker beacon at or near the glide slope intercept altitude of an ILS approach. It is keyed to transmit two dashes per second on a 400 Hz tone, which is received aurally and visually by compatible airborne equipment. The OM is normally located four to seven miles from the runway threshold on the extended centerline of the runway.

Outstanding Resource Water (ORW) – A water or a wetland bordering a water that has been designated by the Massachusetts Department of Environmental Protection as an Outstanding Resource Water (ORW). ORWs include public water supplies, certified vernal pools, and other waters that constitute an outstanding resource as determined by their outstanding socio-economic, recreational, ecological and/or aesthetic values.

Overhead Maneuver – A series of predetermined maneuvers prescribed for aircraft (often information) for entry into the VFR traffic pattern and to proceed to a landing. An overhead maneuver is not an IFR approach procedure. These aircraft shall be considered VFR and the IFR flight plan is canceled when the aircraft crosses the landing threshold on the initial approach portion of the maneuver.

Oxides of Nitrogen (NOX) – Regulated air pollutants representing different combinations of oxygen and nitrogen. The U. S. EPA has established regulations, including a NAAQS, for nitrogen dioxide (NO₂).

Ozone (O₃) – A regulated air pollutant formed from reactions between Volatile Organic Compounds (VOC) and oxides of nitrogen in the

presence of sunlight, primarily during summer months. Also generally known as smog.

P-Q

Particulate Matter (PM_{2.5}) – Regulated fine particle matter in the air with a diameter of 2.5 micron or less. One micron is one-millionth of a meter.

Particulate Matter (PM₁₀) – Regulated coarse particle matter in the air with a diameter of 10 micron or less. One micron is one-millionth of a meter.

PART5 – U. S. EPA model to predict fleet-average emissions of particulate matter from motor vehicles. This function of the PART5 model has been replaced with the MOBILE6 model.

Polychlorinated biphenyl (PCB) – Mixtures of up to 209 individual synthetic chlorinated compounds. PCBs have been used as coolants and lubricants in transformers, capacitors, and other electrical equipment because they don't burn easily and are good insulators. The manufacture of PCBs was stopped in the U.S. in 1977 because of evidence that they build up in the environment and can cause harmful health effects. Products made before 1977 that may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors, and hydraulic oils. There are no known natural sources of PCBs. PCBs are either oily liquids or solids that are colorless to light yellow, and have no known smell or taste.

Precision Approach Path Indicators (PAPI) – A visual aid consisting of a system of lights installed on the side of the runway that provide visual descent guidance information during approach to a runway to provide for the aircraft crossing the runway threshold at an appropriate height. A PAPI is intended primarily for use during VFR weather conditions.

Precision Approach Procedure – A standard instrument approach procedure in which an

electronic glide slope/glidepath is provided; e.g., ILS/MLS and Precision Approach Radar (PAR).

Precision Approach Radar (PAR) – Radar equipment in some Air Traffic Control facilities operated by the FAA and/or the military services at joint-use civil/military locations and separate military installations to detect and display azimuth, elevations, and range of aircraft on the final approach course to a runway. PAR provides both horizontal and vertical guidance to approaching pilots.

Program for Mass Transit (PMT) – A long-range transit plan that evaluates and recommends transit projects to preserve, enhance and expand the MBTA system. The PMT describes the MBTA's fiscally-unconstrained capital investment plan. Any transit project eligible for federal funds must be included in the PMT. The PMT was last revised in January 2004.

Propylene glycol – An organic compound that is used as ingredient in aircraft deicing solutions.

R

Reasonably Available Control Technology (RACT) – Requires the use of reasonably available control requirements to reduce or limit air emissions from sources in areas that do not meet national ambient air quality standards (i.e., non-attainment areas).

Request for Determination of Applicability (RDA) – A filing with the Conservation Commission of a local jurisdiction or the Massachusetts DEP that uses WPA Form 1 to determine whether the Wetlands Protection Act applies to a particular area of land or to specific work planned on a particular area of land.

Response Action Outcome (RAO) – A designation applied to a disposal site, as defined under the Massachusetts Contingency Plan (MCP), 310 CMR 40.0000, at which there is No Significant Risk, also as defined by the

MCP. The goal of assessment and mitigation activities under the MCP is to achieve conditions of No Significant Risk, so attainment of a Response Action Outcome (RAO) is considered a significant milestone in the progression through MCP activities, and in many (but not all) cases serves as an endpoint to those activities.

Record of Decision (ROD) – In the Commonwealth of Massachusetts, a document issued by the Secretary of Environmental Affairs on a project where a waiver of a MEPA threshold or other MEPA requirement has been requested. At the federal level, a decision on an EIS filing.

Runway – A defined rectangular area on land airport prepared for the landing and takeoff run of the aircraft along its length. Runways are normally numbered in relation to their magnetic direction rounded off to the nearest 10 degrees; e.g., Runway 01, Runway 25.

Runway Alignment Indicator Lights (RAIL) – A visual lighting system that provides information on the approach end of the runway

Runway End Identifier Lights (REIL) – See Airport Lighting.

Runway Protection Zone (RPZ) – See Obstacle Free Zone.

Runway Safety Area (RSA) – See Obstacle Free Zone.

Runway Visual Range (RVR) – See Visibility.

S

Simplified Directional Facility (SDF) – A navigational aid used for nonprecision instrument approaches that provides lateral guidance from a final approach fix when the lateral course alignment is offset from the extended runway centerline by more than 3 degrees but less than 30 degrees.

Simplified Short Approach Light System with Runway Alignment Indicator Lights

(SSALR) – A high intensity approach lighting system that provides a visual lighting path for landing aircraft. The SSALR has up to eight sequenced flashing lights and is used as part of a dual-mode ALS (ALSF-2/SSALR) when Category I conditions exist on Category II runways.

Single Event Level (SEL) – The total noise dose, or exposure, resulting from a time-varying sound that is normalized to a one second duration so that exposures of different durations can be compared on an equal basis. Because aircraft noise events last longer than one second, the time-integrated SEL always has a value greater in magnitude than the maximum sound level of the event – usually about seven to ten dB higher for most airport environments.

Small Airplane – An airplane of 12,500 pounds (5,700 kg) or less maximum certificated takeoff weight;

Spill Prevention Control and

Countermeasure Plan (SPCCP) – The cornerstone of the EPA’s strategy to prevent oil spills from reaching the nation’s waters. Requirements for maintaining SPCC Plans are dependent on facility operations and on site storage practices, as regulated under 40 CFR 112. SPCC Plans have prescribed elements for management and inspection of facilities’ storage and handling operations, and are designed to ensure that such facilities put into place containment and other countermeasures that would prevent oil spills from reaching navigable waters.

State Implementation Plan (SIP) – A detailed plan prepared by the states to show how they will comply and maintain compliance with national air quality rules. States prepare SIPs and submit them to the U.S. EPA for approval to meet specific requirements of the Clean Air Act, including the requirement to attain and maintain

the National Ambient Air Quality Standards (NAAQS).

State Register of Historic Places (SR) –

Established by MGL Ch. 9, ss. 26-27C, as amended by Chapter 152 of the Acts of 1982 and Chapter 254 of the Acts of 1988. Regulations promulgated on August 4, 1989 (950 CMR 71.00). The State Register includes properties that meet one of the following criteria: National Historic Landmark; listed or formally determined eligible for inclusion in the National Register of Historic Places; Massachusetts Archaeological/Historic Landmark; Local Landmark; Local Historic District; Regional Historic District; and subject to a Preservation Restriction managed by the Massachusetts Historical Commission. The State Register is updated weekly.

Stormwater Pollution Prevention Plan

(SWPPP) – A plan developed in accordance with the requirements of a General or Individual NPDES permit issued pursuant to the U.S. Clean Water Act. The SWPPP sets forth the activities to be initiated at a site to minimize or prevent pollution of waters of the U.S. A SWPPP may be necessary for existing industries or planned construction projects. The development of the SWPPP includes site characterization and the implementation of specific BMPs to address activities at the site. The U.S. EPA is the permitting authority in Massachusetts. The Massachusetts DEP has review and approval of the SWPPP if the site discharges to an ORW.

Sulfur dioxide (SO₂) – A regulated air pollutant created by the combustion of materials containing sulfur. The U. S. EPA has established regulations, including a NAAQS, for SO₂.

T-U

Tactical Air Navigation (TACAN) – A navigational aid that provides suitably equipped aircraft a continuous indication of bearing and distance to the TACAN station.

Taxi – The movement of an airplane under its own power on the surface of an airport (Part 135.100 – Note). Also, it describes the surface movement of helicopters equipped with wheels.

Taxilane (TL) – See Obstacle Free Zone.

Taxiway (TW) – See Obstacle Free Zone.

Taxiway Safety Area (TSA) – See Obstacle Free Zone.

Terminal Instrument Procedures – TERPS establishes criteria that are used to formulate and publish procedures for instrument approach and departure of aircraft to and from civil and military airports.

Terminal Radar Approach Control (TRACON) – Controls aircraft in the vicinity of a large airport, between the departure or arrival airport and the Air Route Traffic Control Center.

Terminal-Very High Frequency Omnidirectional Range Station – A very high frequency terminal omnidirectional range station located on or near an airport and used as an approach aid.

Threshold – The beginning of that portion of the runway usable for landing.

Time Above a decibel threshold (TA) – Because analyses of decibels are complex and often unfamiliar to the public, the FAA has developed a supplemental noise metric that is non-logarithmic: the amount of time (in minutes or seconds) that the noise source of interest exceeds a given A-weighted sound level threshold. Every time a noise event goes above a given threshold, the number of seconds is accumulated and added to any previous periods that the noise exceeded the threshold. These time-above-thresholds, or Time Above, are usually reported for a 24-hour period. Note that TA does not tell the loudness of the various noise events. Just as a single value of the A-weighted sound level ignores the dimension of

time, so the TA ignores the dimension of loudness.

Time-In-Mode (TIM) – The time an aircraft spend in each mode of the LTO cycle.

Total Noise Exposure (EXP) – The EXP metric was developed in 1982 as a screening tool for Massport to assess changes in the fleet mix of aircraft operating at Hanscom Field overtime. EXP indicates changes in total noise exposure and expected resultant changes in DNL, without the need to prepare noise contours. The metric is calculated by logarithmically summing the representative SELs for each departure of an airplane assuming it flies over a single point on the ground. Similar aircraft types are grouped together in the calculations at creating a "partial EXP" for the group. Partial EXP values for each group are then summed to obtain a single number estimate of departure noise exposure at that reference location. Similar calculations are performed for arrival operations. Separate computations are performed for civil and military operations. Massport maintains a comprehensive database of operations conducted by aircraft heavier than single engine piston aircraft. EXP uses the same summation formula as DNL: logarithmic summation of all noise events over a 24-hour day, with a 10 dB penalty applied to events occurring between 10:00 p.m. and 7:00 a.m.

Total petroleum hydrocarbon (TPH) – A term used to describe a large family of several hundred chemical compounds that originally come from crude oil, which is refined to common petroleum products such as gasoline, motor oil, and jet fuel. Because there are so many different chemicals in petroleum products, it is not practical to measure each of them individually, so TPH testing in the environment is often used as a measure of evidence of release of such products to soils, groundwater, or surface water.

Total suspended solids (TSS) – Solids in water that can be trapped by a filter (the combination of TSS and total dissolved solids together comprise Total Solids). TSS can include a wide variety of material, such as silt, decaying plant and animal matter, industrial wastes, and sewage. High levels of TSS can pose risk to the aquatic life and natural stream processes.

Touch-And-Go – An operation by an aircraft that lands and departs on a runway without stopping or exiting the runway.

Tower – A terminal facility that uses air/ground communications, visual signaling, and other devices to provide ATC services to aircraft operating in the vicinity or an airport or on the movement area. Authorizes aircraft to land or takeoff at the airport controlled by the tower or to transit the airport traffic area regardless of flight plan or weather conditions (IFR or VFR). A tower may also provide approach control services (radar or nonradar).

Traffic Pattern – The traffic flow that is prescribed for aircraft landing at, taxiing on, or taking off from an airport. The components of a typical traffic pattern are upwind leg, crosswind leg, downwind leg, base leg and final approach.

- **Upwind Leg** – A Flight path parallel to the landing runway in the direction of landing.
- **Crosswind Leg** – A flight path at right angles to the landing runway off its upwind end.
- **Downwind Leg** – A flight path parallel to the landing runway in the direction opposite to landing. The downwind leg normally extends between the crosswind leg and the base leg.
- **Base Leg** – A flight path at right angles to the landing runway off its approach end. The base leg normally extends from the downwind leg to the intersection of the extended runway centerline.
- **Final Approach** – A flight path in the direction of landing along the extended

runway centerline. The final approach normally extends from the base leg to the runway. An aircraft making a straight-in approach VFR is also considered to be on final approach.

Transmissometer – An apparatus used to determine visibility by measuring the transmission of light through the atmosphere. It is the measurement source for determining runway visual range (RVR) and runway visibility value (RVV).

Transportation Demand Management (TDM) – Measures that make better use of existing transportation facilities by reducing the peak hour demand for automobile trips, as opposed to increasing roadway capacity. Examples of TDM measures include increased or expanded transit service, carpool/vanpool programs, employee rideshare programs, and staggered work hours.

Transportation Improvements Plan (TIP) – A five-year plan that programs federally fund roadway and transit projects. Metropolitan Planning Organization updates the TIP on an annual basis.

Transportation Management Association (TMA) – A structured organization typically comprised of employers interested in collectively improving transportation access to an area through the implementation of cost-sharing approaches such as Transportation Demand Management (TDM) measures, public advocacy and marketing and information campaigns. The transportation access measures, as well as the dues and organizational structure, are tailored to the specific needs of the TMA membership.

Transportation Management Initiative (TMI) – A program that is administered by MassRIDES on behalf of the Executive Office of Transportation. The program funds a MassRIDES staff coordinator to plan and administer TDM actions with members. Membership in the program is free. Benefits are

provided based on the level of participation in TDM, with employees of partner companies eligible to use MassRIDES's guaranteed ride home program.

Transportation Security Administration (TSA) – Federal agency created as part of the Aviation and Transportation Security Act passed by the U.S. Congress and signed into law on November 19, 2001 and in response to the September 11, 2001 attacks on the World Trade Center and The Pentagon. The agency is charged with developing policies to ensure the safety of U.S. air traffic and other forms of transportation.

Trichloroethylene (TCE) – A synthetic volatile organic compound that is often used as a solvent for resins, oils, and paints, and also as a degreaser, particularly for mechanical parts. It is a colorless liquid with a chloroform like odor, and is considered carcinogenic.

Trip (vehicle) – A trip represents one vehicle entering or leaving a facility. A vehicle entering and leaving a facility represents two vehicular trips.

V

Vacuum-enhanced recovery (VER) – A system of recovery of groundwater or total fluids from a groundwater well, in which the radius of the capture zone of a groundwater pumping system is increased through the application of a high negative pressure differential to the recovery well. VER is typically used when low transmissivity conditions are encountered in a contaminated subsurface formation, and in which capture zones and fluid recoveries are very low under normal pumping conditions.

Vehicle Miles Traveled (VMT) – The product of the number of vehicles on a given roadway by the length of the roadway. The units are vehicle miles per year.

Vehicle Occupancy Rate (VOR) – Number of persons per vehicle.

Vegetation Management Plan (VMP) – A program of actions by Massport at Hanscom Field to comply with FAA regulations and Massachusetts General Laws regarding protected airspace. The VMP includes vegetation removal project addresses obstructions. Massport implemented the VMP in 2004. Since then, the VMP has moved into a maintenance phase.

Very-High-Frequency Omnidirection Range (VOR) – A ground-based electronic navigation aid transmitting very high frequency navigation signals, 360 degrees in azimuth, oriented from magnetic north. Used as the basis for navigation in the National Airspace System. The VOR periodically identifies itself by Morse Code and many have an additional voice identification feature. Voice features may be used by Air Route Traffic Control Center or for transmitting instructions/information to pilots.

Visibility – The ability, as determined by atmospheric conditions and expressed in units of distance, to see and identify prominent unlighted objects by day and prominent lighted objects by night. Visibility is reported as statute miles, hundreds of feet or meters.

- **Flight Visibility** – The average forward horizontal distance, from the cockpit of an aircraft in flight, at which prominent unlighted objects may be seen and identified by day and prominent lighted objects may be seen and identified by night.
- **Ground Visibility** – Prevailing horizontal visibility near the earth's surface as reported by the United States National Weather Service or an accredited observer.
- **Runway Visual Range (RVR)** – An instrumentally derived value, based on standard calibrations, that represents the horizontal distance a pilot will see down the runway from the approach end. It is based on the sighting of either high intensity runway lights or on the visual contrast of other

targets, whichever yields the greater visual range. RVR, in contrast to prevailing or runway visibility, is based on what a pilot in a moving aircraft should see looking down the runway. RVR is horizontal visual range, not slant visual range. It is based on the measurement of a transmissometer made near the touchdown point of the instrument runway and is reported in hundreds of feet. RVR is used in lieu of RVV and/or prevailing visibility in determining minimums for a particular runway.

- **Touchdown RVR** – The RVR visibility readout values obtained from RVR equipment serving the runway touchdown zone.
- **Mid-RVR** – The RVR readout values obtained from RVR equipment located midfield of the runway.
- **Rollout RVR** – The RVR readout values obtained from RVR equipment located nearest the rollout end of the runway.

Visual Approach – An approach wherein an aircraft on an IFR flight plan, operating in VFR conditions under the control of an air traffic facility and having an air traffic control authorization, may proceed to the airport of destination in VFR conditions.

Visual Approach Slope Indicators (VASI) – See Airport Lighting

Visual Flight Rules (VFR) – Rules that govern the procedures for conducting flight under visual conditions. The “VFR” is also used in the United States to indicate weather conditions that are equal to or greater than minimum VFR requirements. In addition, it is used by pilots and controllers to indicate type of flight plan.

Visual Flight Rules (VFR) Conditions – Weather conditions equal to or better than the minimum for flight under visual flight rules.

Visual Meteorological Conditions – Meteorological conditions expressed in terms of

visibility, distance from cloud, and ceiling equal to or better than specified minima.

Volatile Organic Compounds (VOC) – Hydrocarbons associated with motor fuels that are highly reactive and may help form ozone.

VORTAC - A navigation aid providing VOR azimuth, TACAN azimuth, and TACAN distance measuring equipment (DME) at one site.

W-Y

Wetlands Protection Act (WPA) – An Act (MGL Chapter 131 Section 40) that protects Massachusetts wetlands resources and ensures that the beneficial functions of these resources are maintained. Projects that affect wetlands are required to avoid impacts where possible, minimize unavoidable impacts, and mitigate for unavoidable impacts. Proponents of projects in wetlands or in the buffer zone around them must apply for an Order of Conditions from the municipal Conservation Commission.

Z

Zero emissions vehicle (ZEV) – A vehicle that has no air pollution emissions directly associated with it (e.g. vehicles powered with electricity or hydrogen fuel cells).

Distribution List

List of Reviewers

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The Honorable Michael Barrett
MA State Senate
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The Honorable Kenneth J. Donnelly
MA State Senate
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The Honorable Cory Atkins
MA House of Representatives
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The Honorable Jay R. Kaufman
MA House of Representatives
State House, Room 34
Boston, MA 02133

The Honorable Ken Gordon
MA House of Representatives
State House, Room 39
Boston, MA 02133

Senator Thomas McGee
MA State House
State House, Room 109C
Boston, MA 02133

The Honorable Thomas P. Conroy
MA House of Representatives
State House, Room 236
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The Honorable Thomas M. Stanley
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Massachusetts Department of Transportation
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Massachusetts Department Agricultural
Resources

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Amherst MA 01003

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Natural Heritage and Endangered Species
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Massachusetts Division of Fish & Wildlife
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Massachusetts Department of Public Health
Director of Environmental Health
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Massachusetts Water Resource Authority
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Boston, MA 02129

Massachusetts Bay Transportation Authority
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Bedford Public Library
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Bedford Board of Health
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Bedford, MA 01730

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Board of Selectmen
Town of Bedford
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Boston Transportation Department
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Carey Memorial Library
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Town of Lincoln
Hanscom Area Town Selectmen, 7 Conant Road
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Bedford, MA 01730

Deborah Kreiser-Francis, Historic Site Manager
The Old Manse
The Trustees of Reservations
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John H. Adams, Executive Director
The Walden Woods Project
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Lincoln, MA 01773-3004

Individuals

The 2012 Hanscom Environmental Status and Planning Report is available on the Massport website at www.massport.com.

Appendix A Draft Scope, MEPA Certificate, and Responses to Comments

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hanscomfield



Request For Qualifications

**Environmental Permitting Services Related to the Preparation of the
2012 L.G. Hanscom Field Environmental Status & Planning Report
Bedford, Massachusetts**

EOEEA Number: 5484/8696

Massachusetts Port Authority

March 1, 2012

**Request for Qualifications (RFQ)
For Environmental Permitting and Planning Services
Related to the Preparation of the 2012 Hanscom Field Environmental Status and
Planning Report**

The MASSACHUSETTS PORT AUTHORITY (Massport) is soliciting proposals from qualified aviation planning and environmental permitting consultants to assist the Authority with preparing and filing the Hanscom Field 2012 Environmental Status and Planning Report (ESPR).

Background Information

Hanscom Field is owned and operated by the Authority and is Massachusetts's premier general aviation airport. Hanscom's role is as a general aviation reliever to Logan International Airport. The Massachusetts Secretary of the Executive Office of Energy and Environmental Affairs (Secretary) currently requires that the Authority prepare an ESPR every five years to evaluate the cumulative effect of growth and change at Hanscom Field and provide data and analyses on noise, ground transportation, air quality, and water quality. The last ESPR was completed in 2005. The ESPR was deferred until analysis year 2012 due to the economic downturn and the number of aviation operations, which have remained below the 2005 and future analysis years.

In 1985, Massport initiated a series of environmental studies at Hanscom that started with the Generic Environmental Impact Report (GEIR) and was followed by the 1995 GEIR, the 2000 ESPR, and the 2005 ESPR. The ESPR includes a retrospective analysis of Hanscom Field impacts and analyses for future operating and environmental conditions. The ESPR has become an effective planning tool from which the Authority's policy and program developments are derived. The ESPR also provides long-range projections of cumulative environmental conditions against which the effects of individual projects can be compared. The ESPR allows the reader to see historical environmental information, current information, and future analysis of environmental effects and planning scenarios while providing a foundation for future project planning and analyses at Hanscom Field. The ESPR will also describe Massport's vision for the coordinated use of its three airports: Logan, Hanscom, and Worcester.

The Authority filed its 2005 ESPR with the Executive Office of Energy and Environmental Affairs (formerly the Executive Office of Environmental Affairs) in November 2006. That comprehensive document contains, among other things, an extensive discussion on aircraft and ground transportation, and detailed information on such technical issues as noise abatement, air quality improvement, ground access, and water quality management. The Certificate issued by the Secretary on March 29, 2007, determined that the 2005 ESPR filing "adequately and properly complies with the Massachusetts Environmental Policy Act."

Massport filed the Proposed Scope for the 2012 Hanscom Field ESRP with the Executive Office of Energy and Environmental Affairs on February 29, 2012. A copy of The Proposed 2012 Hanscom ESRP Scope. In advance of the Secretary's Certificate the proposed scope for the 2012 Hanscom ESRP Scope is enclosed. The Certificate of the Secretary of Environmental Affairs will establish the Scope for the 2012 L. G. Hanscom Field Environmental Status and Planning Report. This contract will also include airside and landside planning services. Massport will develop a refined work order for preparation of the 2012 ESRP and associated planning (to be completed under this contract; the project budget is approximately \$650,000) upon receipt of the Secretary's Certificate.

The Secretary's Certificate requires that the major areas of analyses for the 2012 ESRP include, but are not limited to, aviation planning, landside planning, ground access, noise, air quality, water quality, cultural and historical resources, sustainability and airport mitigation. Specific supplemental studies may also be required including both airside and landside planning for Hanscom Field scenarios for 2020 and 2030 (aviation forecasts for these scenarios have been completed).

Consultant Services

Massport expects this work to be done through a prime consultant with subconsultants (Consultant or Team). The Consultant will be expected to do all work necessary to produce the 2012 Hanscom Field ESRP.

Reporting Format

The reporting format for the 2012 ESRP will be similar to that used in the 2005 ESRP (please see the Massport website for a copy of the 2005 Hanscom ESRP). Going forward, the Authority wishes to explore ways to create a more streamlined, user friendly reporting format. The objectives of the new formats are several: (1) to reach a wider audience that is interested in the environmental issues at L. G. Hanscom Field but that is not necessarily trained to understand and interpret technical details; (2) highlight Massport's environmental initiatives and achievements at L. G. Hanscom Field; and (3) to compare and make available the technical details and analyses presented in prior environmental reports.

Project Schedule

Massport anticipates the filing of the 2012 ESRP in mid 2013. Since the Notice to Proceed is planned for April/May 2012, the response to the RFQ and any contract awarded to the successful team will confirm the Consultant's commitment to meet the filing dates.

Submittal Requirements

The submittal shall include:

1. Detailed discussion of the Team's proposed approach to preparing the ESPR in accordance with the Proposed Scope (or the Certificate of the Secretary of Environmental Affairs establishing the Scope if available) for the 2012 L. G. Hanscom Field ESPR and any additional tasks that the Team deems necessary in order to receive a Certificate of Adequacy from MEPA on the document;
2. Overview of the project managers and Team's relevant qualifications and experience;
3. Resumes for key staff to be assigned to the project and availability of the project manager for this effort.
4. Organizational chart and staffing plan description of specific project responsibilities and availability of key staff, including subconsultants;
5. Overall project schedule, highlighting specific milestones and assumptions and ability to meet the filing deadline for the ESPR and budget, as estimated by the Authority.
6. The Consultant shall indicate the level of effort for each of the proposed tasks in the scope. It is expected that the contract for the ESPR with the successful Consultant will be based on a not-to-exceed fee.
7. Anticipated MBE/WBE participation (including proof of certification) and Affirmative Action efforts. MBE/WBE Certification shall be current at the time of submittal and a copy of the MBE/WBE certification letter from the State Office of Minority and Women Business Assistance (SOMWBA), or other agency which utilizes criteria similar to those found in Title 49 CFR, Part 26 should be provided in the submittal.

Submissions are limited to a maximum of 30 double sided sheets (60 printed pages), not including resumes, firm brochures, and **no** acetate covers. Fifteen copies of the Proposals should be submitted to Thomas W. Ennis, Senior Project Manager, Economic Planning & Development, Massachusetts Port Authority, Logan Office Center, One Harborside Drive, East Boston, MA 02128. All submissions must be received by the Economic Planning and Development Department, Logan Office Center, second floor, room 205S no later than **April 5, 2012 at 12:00 Noon**. Late submittals will not be accepted.

Pre-Proposal Briefing Session

A pre-proposal briefing session will be held at 10:00 am on Weds. **March 14, 2012** at the Logan Office Center (second floor EP&D Conference Room), One Harborside Drive, East Boston, MA. All questions shall be submitted by e-mail to Tom Ennis at tennis@massport.com no later than 5:00 pm on March 16, 2012. Questions and Massport response will be distributed to briefing session attendees by March 23, 2012. The session shall consist of a staff presentation followed by questions and answers.

Selection Criteria

Each Consultant will be evaluated on the basis of information provided by the prime Consultant and each of the subconsultants in its proposal concerning:

1. Relevant and demonstrated project experience of each member of the Team particularly in relation to aviation, environmental reviews, cumulative impacts, airport planning and development, land planning, transportation planning (regional and ground access), air quality assessment, noise monitoring and analysis, water quality analysis, cultural and historical resources, sustainable development, environmental permitting regulations, and preparation of similar environmental documents.
2. Project manager and individual project Team member qualifications and experience;
3. Quality, creativity, and time required for the proposed approach;
4. Familiarity with Massachusetts environmental regulations as they apply to L. G. Hanscom Field; knowledge and demonstrated sound judgment regarding relevant state and federal environmental regulations and technical analyses;
5. Project organization, document control and sub consultant management;
6. Ability to provide the required services and meet the filing deadline in the most timely and cost effect manner.
7. The Consultant's fee shall be negotiated. The budget to complete the 2012 ESPR is estimated to be approximately \$650,000.
8. MBE/WBE composition of the team.
9. Other criteria that Massport deems appropriate.

Please note that the criteria listing above are not set forth in an order of priority. The Authority's analysis of the proposals received will weigh each of the criteria, as it deems appropriate.

The Authority expects that it will develop a list of qualified Consultants from the submitted proposals. Proposals that do not meet the requisite submittal requirements or demonstrate the specified experience will, at the sole discretion of the Authority, be eliminated.

In the interest of maintaining a fair selection process, consultants are respectfully requested to refrain from contacting the Authority staff or environmental regulators with regard to this project prior to the submittal deadline. Any questions with respect to the requirements of the RFP should be submitted in writing to Tom Ennis by email at

tennis@massport.com. Questions and responses will be available for review by contacting Mr. Ennis. The 2005 Hanscom Field ESPR is available for review at Massport's website.

The Authority is soliciting competitive proposals pursuant to a determination that such a process best serves the interests of the Authority and the general public, and not because of any legal requirement to do so. The Authority reserves the right to accept one or more of the proposals, to reject proposals, to modify or amend with the consent of the proposer any proposal prior to acceptance, to terminate this RFP process, and to effect any agreement otherwise, all as the Authority in its sole judgement may deem to be in its best interest.

By responding to this solicitation, consultants agree to accept the terms and conditions of the Authority's standard work order agreement, a copy of the agreement can be found on the Authority's web page at www.massport.com. The exception to this standard agreement is the insurance requirement of \$1,000,000 of automobile liability insurance.

The Consultant selected by the Authority will be required to execute a standard Authority/Consultant contract with such changes as the Authority deems appropriate to this engagement.

Massachusetts Port Authority



February 2012 Proposed Scope

2012 L.G. Hanscom Field
Environmental Status & Planning Report
Bedford, Massachusetts

EOEEA Number: 5484/8696

Submitted to:
Executive Office of Energy and Environmental Affairs

Submitted by:
Massachusetts Port Authority





Massachusetts Port Authority
One Harborside Drive, Suite 200S
East Boston, MA 02128-2909
Telephone (617) 428-2800
www.massport.com

February 29, 2012

Secretary Richard K. Sullivan, Jr.
Executive Office of Energy and Environmental Affairs
Attn: MEPA Office
100 Cambridge Street, Suite 900
Boston, MA 02114

Re: Proposed Scope
2012 L. G. Hanscom Field Environmental Status & Planning Report
Bedford, MA
EOEA Number: 5484/8696

Dear Secretary Sullivan and Director Valley-Bartlett:

The Massachusetts Port Authority (Massport) is pleased to submit for your review this Proposed Scope for the 2012 L. G. Hanscom Field Environmental Status & Planning Report (ESPR), the next filing in an ongoing review and evaluation of current and potential future operating and environmental conditions at Hanscom Field. The Proposed Scope is being submitted in accordance with the provisions of the Massachusetts Environmental Policy Act (MEPA), G.L. Chapter 30, Sections 62-62H and its regulations, 301 Code of Massachusetts Regulations (CMR) 11.00. The Proposed Scope responds to the Secretary's March 29, 2007 Certificate on the 2005 ESPR. A copy of the reviewers list is also attached.

Massport is requesting an extended 45-day comment period to accommodate community review and as requested by the Hanscom Field Advisory Commission (HFAC), with the close of comments on April 20, 2012. In addition to the MEPA Scoping Session, Massport will also hold an additional public meeting in mid-April and has offered to participate in additional community meetings within the 45 day review period to discuss the scope, as needed.

Tom Ennis, Senior Project Manager/Senior Planner will again be serving as the ESPR Project Manager. Tom and members of Massport's staff are available to discuss the ESPR and attached documents with you or your staff if needed. Please contact Tom at 617-568-3546 or me at 617-568-3524 with any questions or comments.

Sincerely,

Stewart Dalzell, Deputy Director
Environmental Planning and Permitting
Massachusetts Port Authority

Attachments

Cc: T. Ennis/Massport
B. Desrosiers/Massport

Operating

Boston Logan International Airport • Port of Boston general cargo and passenger terminals • Tobin Memorial Bridge • Hanscom Field • Boston Fish Pier • Commonwealth Pier (site of the World Trade Center Boston) • Worcester Regional Airport

RECYCLED PAPER

**Proposed Scope
2012 L. G. Hanscom Field
Environmental Status & Planning Report
February 2012**

PROJECT NAME: 2012 Hanscom Field Environmental Status & Planning Report
PROJECT LOCATION: Bedford, Massachusetts
EOEA NUMBER: 5484/8696
PROJECT PROPONENT: Massachusetts Port Authority (The Authority)

The Authority is committed to a multi-modal, multi-airport, multi-state regional transportation program that will satisfy future regional aviation demand. A key component of that transportation program is the use of regional airports to complement Boston-Logan International Airport (Logan). L.G. Hanscom Field, which is located in the four towns of Bedford, Concord, Lincoln, and Lexington, is New England's premier general aviation (GA) airport. Minute Man National Historical Park is located just south and west of the airport in Lincoln and Concord. As a reliever to Logan, Hanscom Field provides airside relief by annually serving approximately 170,000 GA operations. Hanscom Field handles over six times more GA operations than occur at Logan. The airport has supported niche commercial service. This role for Hanscom Field was established in the Master Plan for the airport in 1978, clarified in the 1980 Noise Rules, restated in the 1995 Generic Environmental Impact Report (GEIR), the 2000 L. G. Hanscom Field Environmental Status & Planning Report (ESPR), the 2005 ESPR, and continues to be the program for the future.

Hanscom Field's Master Plan and Noise Rules

The Authority assumed ownership of Hanscom Field in 1974. The airport is located approximately 20 miles northwest of Boston just outside Route 128/I-95 and is convenient to most of metropolitan Boston. The Federal Aviation Administration (FAA) identifies Hanscom Field as a reliever airport. As such, its primary role in the regional aviation system is to accommodate regional GA needs, which has included some commercial and cargo service. This allows larger nearby airports to concentrate on large-scale commercial and cargo activity.

In 1978, the Authority prepared a Master Plan for the airport. The preparation of the Master Plan included a lengthy and comprehensive public process. In 1980, after additional public process, Massport adopted the Hanscom Field Noise Rules, which were an outgrowth of the Master Plan. The Master Plan and the 1980 Noise Rules remain the framework for airport planning and operations today.

The variety of aviation activities at Hanscom Field include private corporate aviation, recreational flying, pilot training, air charter, cargo, commuter service and limited military flights. The Master Plan and the 1980 Noise Rules contemplate and provide for commercial airline service. In fact, the 1980 Noise Rules specifically allow for passenger aircraft with up to 60 seats. Commercial airlines have operated periodically at Hanscom Field since the mid-1970s. Pan Am is the most recent airline to provide commercial passenger services and Streamline currently provides scheduled charter service.

History and Purpose of Environmental Status and Planning Report

The Massachusetts Secretary of the Executive Office of Energy & Environmental Affairs (Secretary) has, since 1985, requested that the Authority prepare an Environmental Status and Planning Report (ESPR) every five years to evaluate the cumulative effect of growth and change at Hanscom Field and provide data and analyses on noise, ground transportation, air quality,

and water quality. The original GEIR, the 1995 GEIR Update, the 2000 ESPR, the 2005 ESPR, and now the 2012 ESPR provide a retrospective analysis of the environmental effects of Hanscom Field while including analyses for future conditions. The ESPR was deferred until analysis year 2012 due to the economic downturn and the number of aviation operations, which have remained well below the 2005 and future analysis years.

As a result, these documents remain an effective planning tool from which the Authority's policy and program developments are derived. The 2012 ESPR will present an overview of the operational environment and planning status of Hanscom Field and will provide long-range projections of environmental conditions against which the effects of future individual projects can be compared. The ESPR will allow the reader to see historical environmental information, current information, and a forecast of future environmental effects at Hanscom Field. The ESPR does not replace the requirement for filing an Environmental Notification Form (ENF) for a specific project if that project meets or exceeds a MEPA regulation threshold.

The Authority filed its 2005 Draft ESPR with the Executive Office of Environmental Affairs (EOEA) in November 2006, the Draft ESPR received its Certificate on February 15, 2007 where the Draft ESPR was accepted as a Final ESPR (FESPR) and was noticed in the Monitor on February 20, 2007. The Secretary issued the MEPA Certificate for the FESPR on March 29, 2007. The ESPR contains, among other things, an extensive discussion on air and ground transportation, cultural and historical resources, and detailed information on such technical issues as noise abatement, air quality, ground access, and water quality management. The MEPA Certificate issued by the Secretary on March 29, 2007 determined that the 2005 ESPR "adequately and properly complies with the Massachusetts Environmental Policy Act." The Secretary's Certificate requires that the major areas of analyses for the next ESPR include, but are not limited to, aviation planning, landside planning, ground access, noise, air quality, water quality, cultural and historical resources, sustainability and airport mitigation.

Public Review and Participation

In developing this proposed Scope, the Authority reviewed the Final MEPA Certificate for the 2005 ESPR. Per the proposed schedule, the Authority will convene the following:

- Hold a public meeting to discuss the proposed MEPA scope which will be in addition to the MEPA scoping session
- Convene up to four technical workshops during the public review process for the ESPR which will be in addition to the MEPA hearing for the ESPR.

Format of the 2012 ESPR

The 2012 ESPR will follow the general format of the 2005 ESPR. Massport proposes to prepare a single ESPR, similar to what is done at Logan. The 2005 Hanscom ESPR ended up being a single document because EOEEA accepted the 2005 ESPR Draft as the Final ESPR. In addition, Massport provides the Yearly Noise Report and the State of Hanscom every year to the public. Detailed ESPR technical studies will be summarized in a readable format to illustrate clearly the implications of recent trends, existing conditions and potential future scenarios. The ESPR will build on the base information developed for the 2005 ESPR, presenting policy considerations and an overview of the airport's current and potential future role within the regional planning context, including a status report on the Authority's proposed planning initiatives and projects. The 2012 ESPR technical studies will include analysis of airport activity levels, noise, ground access, air quality, water quality, natural resources, cultural and historical resources, and sustainability. The chapters on ground transportation management, noise, air quality, and water quality will include the following sections:

- Discussion of analysis methodologies and assumptions

-
- Report of 2012 conditions in comparison to previous years
 - Prediction of 2020 and 2030 conditions

Forecasted activity levels for the future years may occur earlier or later than the forecast, but the analysis years of 2020 and 2030 will provide useful parameters for the analytical framework.

CD-ROM versions and limited printed copies of the ESPR will be available for public review. The ESPR will be posted on the Authority's web page. Supporting technical appendices will be provided as necessary. The following describes the proposed ESPR sections.

I. Introduction

This section will generally introduce the ESPR and place it in its environmental and regulatory context. This section will:

- Summarize the evolution of the Hanscom Field environmental review process.
- Describe the analysis framework for the environmental reporting and technical studies to be conducted.
- Describe the organization of the 2012 Hanscom Field ESPR.
- Summarize the major sections of the ESPR, with supporting graphics and data tables.

II. Facilities and Infrastructure

This section will update information presented in the 2005 ESPR regarding the airfield and its supporting infrastructure and utility system, including:

- The use and storage of hazardous materials at Hanscom Field, including jet fuel use and spill prevention efforts
- The status of the Authority's tenant audit program
- The current status of the 21E sites at Hanscom Field

III. Airport Activity Levels

This chapter will report on airport activity levels for 2005 to 2012 and describe the new forecasts of aviation activity for 2020 and 2030. This is based on aviation forecasts done for all three Massport airports; Logan, Hanscom, and Worcester. The ESPR will use forecasts to assist in developing fleet projections for each future analysis year.

The 2012 ESPR will describe historic airport activity levels. The ESPR uses specific analysis years to integrate airport activity levels with other areas of analysis, such as traffic projections. The ESPR will provide an update of activity levels at Hanscom Field according to the following:

- Report on aircraft fleet mix and on activity levels of GA, commuter and military operations from 2005 to 2012.
- Compare 2005-2012 activity levels to historic trends.
- Compare actual 2012 activity levels to forecasted 2010 activity levels from the 2005 ESPR.
- Report on current and future trends within the airline industry.

The ESPR will utilize forecasts developed for aviation activity for 2020 and 2030 based on recent trends at Hanscom Field and with consideration of the role that the airport plays in the regional airport system. The ESPR will report actual changes in fleet mix and aircraft operations at Hanscom Field – both increases and decreases – and compare these data to the

range of future activity levels and fleet mix defined by the moderate growth scenarios of the 2005 ESPR. Differences between actual and previously forecast activity levels will be explained and will be reflected in the underlying assumptions for the 2020 and 2030 forecasts. The forecasts will also include coordination with forecasting for the Logan ESPR.

- Prepare a 2020 growth scenario for activity levels and passenger forecasts.
- Prepare growth scenario for activity levels that will vary the fleet mix and passenger forecasts for the year 2030, which is consistent with the Logan ESPR and other regional planning efforts.

The fleet mix of the growth scenarios will include GA, military, commuter service and some cargo activity consistent with the 1978 Master Plan and 1980 Noise Rules. The scenarios will be based on recent trends at the airport as well as regional and national aviation trends.

IV. Airport Planning

The Authority continues to assess planning strategies for operating an efficient airport in an environmentally sensitive manner. As owner and operator of Hanscom Field, the Authority also must accommodate and guide airport tenant development. This section will describe the status of planning initiatives and projects for the:

- Terminal Area
- Airside Area
- Landside Area

This chapter will also report planning and development initiatives by the Minute Man National Historical Park, the Hanscom Air Force Base and the four contiguous towns that affect Hanscom Field and are affected by Hanscom Field.

V. Regional Transportation Context

Hanscom Field is the premier GA facility serving Massachusetts and the New England region. The ESPR will describe the role of Hanscom Field in the region's transportation system, and will report on the Authority's efforts to strengthen the regional transportation system and on its cooperative efforts with other transportation agencies to promote an efficient regional aviation system with improved public/private transportation access. The ESPR will also describe Massport's system of three airports and efforts to better utilize these facilities. This chapter will update the information provided in the 2005 ESPR with the most current information provided in the Logan EDRs and ESPR in relation to Hanscom Field and will include the following:

- For 2012, a report on regional airport operations, passenger activity levels, and the status of plans and new improvements as provided by regional airport authorities and a report on recent rail service initiatives by others that could affect air passenger travel including the North-South Station Rail Link, Acela Service, and bus service.
- A discussion of the role that Logan International Airport plays in intercity travel choices.
- Diversion opportunities to alternative modes and to New England airports.
- A report on the integration of New England regional airport facilities as a regional system
- A report on Hanscom Field's role in the GA airport network.
- A report on the current status of the ground access improvements at the four New England regional airports (Logan International Airport, T. F. Green Airport, Manchester Airport and Worcester Regional Airport) by state transportation agencies, including projected dates for completion of studies and/or construction

and an analysis to quantify the effects of these measures upon projected passenger levels at each of the airports.

In addition, the ESPR will report on the Authority's efforts to promote service at Worcester and other airports, as well as other Authority involvement to promote the regional transportation system.

A report on relevant regional and local highway studies and transit projects will be included.

VI. Ground Transportation

The ESPR will report on Ground Transportation conditions using the following indicators:

- Traffic, roadway and access analysis results
- Mode share data
- Alternative transportation modes; availability and use.
- Parking demand and management information

Background growth in traffic within the Study Area attributed to Hanscom Field as compared to other area sources will be evaluated. The Study Area for the traffic analysis in the 2005 ESPR was bounded by Route 2A, Old Bedford Road, Route 62, Routes 4/225 and Route 128/I-95. The 2012 ESPR will include the fourteen intersections that were counted for the 2005 ESPR within this Study Area. The 2012 ESPR will identify and evaluate those Study Area intersections that Hanscom Field traffic contributes 10-percent or more to the existing traffic volumes on each intersection approach. The 2012 ESPR will also use this approach to evaluate the Study Area intersections for the forecast activity levels and years.

Analyses conducted in support of the 2005 ESPR and other available information indicate that Hanscom Field currently does not have a sufficient commuting population to support a Transportation Management Association (TMA). The potential for developing partnerships with abutters and area businesses to facilitate a regional Transportation Demand Management (TDM) approach will be discussed in the ESPR. Other special topics will address recent studies, and issues raised in previous ESPR Certificates, reviewers' comments, and will:

- Report available information from the Authority's survey of Hanscom Field employees.
- Describe TDM strategies including potential for participation in a TMA.
- Review, summarize and analyze, as necessary, existing metropolitan transportation documents and report as to how they relate to Hanscom Field access.

VII. Noise

The Noise chapter of the ESPR will report current conditions for the year 2012 and projections for the forecast activity levels and years using the following indicators:

- EXP as calculated in accordance with FAA prescribed standards for the Integrated Noise Model (INM) and past practice at Hanscom Field
- Day-Night Average Sound Level (DNL) contours.
- Time-Above (TA) contours for a Given Threshold

All noise contour levels will be computed using the INM. The DNL levels depicted will be based on accepted EPA and FAA guidelines. Impacts assessment for both DNL and TA will be based on data from the 2010 U.S. Census. The ESPR will present the noise data from the

six permanent monitoring stations at Hanscom Field including minimum, maximum and average daily DNL values. Special topics will address recent studies, and issues raised in previous ESPR Certificates, reviewers' comments, and will include, in consultation with the Authority:

- A report on the Fly Friendly program at Hanscom Field and recommended touch and go procedures over the MMNHP.
- An analysis and review for areas that are affected by noise from aircraft upon start-up and take-off roll.
- Update on the incorporated recommendations from the 1999 Report of the Hanscom Field Noise Workgroup.
- Update on new noise monitoring system.

VIII. Air Quality

The Air Quality chapter of the 2012 ESPR will report current conditions for the year 2012, industry update on airport-related greenhouse gasses (GHG's), and projections for the forecast activity levels and years using the following indicators:

- Emissions Inventory for:
 - Carbon Monoxide (CO)
 - Oxides of Nitrogen (NOx)
 - Volatile Organic Compounds (VOCs)
 - Particulate matter (PM10) and (PM2.5)
 - Green House Gases (GHG)
- Available monitoring results for:
 - Ozone Precursors
 - Nitrogen Dioxide (NO2)

IX. Wetlands/Wildlife/Water Resources

The ESPR will include the most recent, wetlands delineation, and the identified vernal pools. The ESPR will report wildlife habitat mapping using available information from Massachusetts Natural Heritage and Endangered Species Program (NHESP). The ESPR will provide an update of the Authority's vegetation management program at Hanscom Field.

The ESPR will report on any incremental changes to the Hanscom Field storm water management system and to the Storm Water Pollution Prevention Plan (SWPPP). The ESPR will report on the water quality monitoring program at the Shawsheen River. The ESPR will provide any available public information on the National Pollutant Discharge Elimination System (NPDES) permit, and the SWPPP. Reporting indicators for water quality improvement will include NPDES Permit monitoring results. The ESPR will also report on the deicing monitoring program. The 2012 ESPR will also report on the Vegetation Management Plan, the Hanscom Field Grassland Management Program and all associated monitoring and maintenance.

X. Cultural and Historical Resources

The 2012 ESPR will review and update the extensive data on historic and archeological resources completed as part of the 2005 Hanscom Field ESPR. The most current version of the State Register of Historic Places and the files of the Massachusetts Historical Commission will be reviewed, as will previous available planning studies conducted within or adjacent to Hanscom Field. This information will be compared to the 2005 ESPR and updated where appropriate in the 2012 ESPR.

XI. Sustainable Development and Environmental Management System

The Sustainable Development and Environmental Management System (EMS) chapter of the ESPR will report on the development of the Authority's Sustainable Development Program and the EMS Program at Hanscom. The Authority received an ISO 14001 Certification for Hanscom Field in 2001, making it the first airport in the nation to qualify. The Certification establishes objectives and targets, monitoring procedures and roles and responsibilities to track and manage the environmental performance of Hanscom Field. This chapter will include a discussion of the following:

- Summary of existing sustainable practices currently being undertaken by the Authority at Hanscom Field
- Report on recycling policy and efforts
- Report on toxic reduction at the airport
- Report on the EMS Program at Hanscom Field, including the ISO 14001 Certification
- Opportunities for sustainable development practices

XII. MEPA Documentation

This section will include a copy of the Secretary's 2007 Certificate on the 2005 Hanscom Field ESPR, a copy of the Secretary's Certificate on the scope for the 2012 ESPR, a reviewers list and a glossary of terms. Supporting Technical appendices will be included in the report as necessary. The ESPR will respond to comments on the Proposed Scope in a topical format.

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The following is a list of summarized comments submitted to the Secretary of Energy and Environmental Affairs (EEA) during the MEPA public comment period when MEPA issued a draft scope for the 2012 Hanscom ESPR. For each comment, a formal response from Massport is provided. The reader may also be referred to a specific section of the 2012 ESPR where a more detailed answer to the comment can be found.

Table A-1 Response to Comments

Number	Comment	Response
EEA Secretary's Certificate, May 18, 2012		
Facilities and Infrastructure		
EEA-1	Describe use and storage of hazardous materials including jet and leaded fuel, and spill prevention measures	Massport has developed a Spill Prevention Control and Countermeasures (SPCC) Plan that covers general Massport operations. Tenants that store a total of more than 42,000 gallons of oil in underground storage tanks (USTs) and/or more than 1,320 gallons of oil in ASTs or containers are required to have a SPCC Plan as required under 40 CFR 112 (Oil Pollution Prevention). For more information, see Section 2.4.6.
EEA-2	Describe deficiencies in the water and wastewater distribution systems	No deficiencies have been identified in Hanscom's water and wastewater systems. These facilities are described in Sections 2.4.3 and 2.4.4 respectively.
EEA-3	Compare changes in water demand and wastewater between 2005 and 2012, and projections for 2020 and 2030	The history of water use from 1988 to 2012 is presented in Table 2-3. Projections for future water usage have been generated based on the expected increase in airport operations. See Section 2.4.3.
EEA-4	Identify Massport's water conservation measures at Hanscom	Water conservation measures are directed by Massport's Sustainable Design Guidelines applicable aspects of LEED. See Section 11.3.3.
EEA-5	Identify infiltration/inflow removal process for the MWRA wastewater system	A summary of the MWRA's annual infiltration/inflow reduction report for Lexington is provided in Section 2.4.4. A variety of projects are being studied and implemented in the Town of Lexington, but none are located at Hanscom.
EEA-6	Status of Massport's tenant audit program	Massport continues to work cooperatively with tenants to ensure compliance with federal and state laws. The Environmental Audit Program is summarized in Section 9.15.
EEA-7	Status of 21E sites	Site remediation was completed in 2005 for the only MassDEP-listed disposal site that was open. Massport submitted documents to MassDEP and the U.S. EPA on May 22, 2006 to bring this site to regulatory closure. See Section 2.4.12.
EEA-8	Size and use of all existing structures and parking areas	A current inventory of parking areas and occupancy was conducted as part of the 2012 ESPR. See Section 2.4.2 and Table 2-2.
Airport Activity Levels		
EEA-9	Report on activity levels from 2005 to 2012 and historic trends	Hanscom's total aircraft operations have declined by 2.0 percent annually from approximately 218,000 operations in 2000 to 166,000 operations in 2012. These levels are considerably lower than peak operations of more than 300,000 in 1970. However, GA at Hanscom Field has recovered with an increase in operations of approximately 11 percent since 2009. See Section 3.4.
EEA-10	Forecasts for 2020 and 2030 including fleet projections including comparison to previous forecasts	GA activity at Hanscom Field is forecast to increase from approximately 164,800 operations in 2012 to 166,515 operations in 2020 and 190,600 operations in 2030. See Section 3.5.
EEA-11	Explain process a commercial airline must follow to initiate service at Hanscom	Procedures for new commercial service provider entrants are described in Section 3.4.5.1.
EEA-12	Consider the effects of federal military base closings	The forecasts assume that military operations will continue but remain low in future years. See Section

Number	Comment	Response
		3.5.
Airport Planning		
EEA-13	Status of planning initiatives for terminal area, airside, and landside	Planning initiatives are described in Chapter 4 and listed in Table 4-5.
EEA-14	List projects in 5-year capital improvement program and potential applicability of MEPA review	Massport's 5-year capital improvement program is described in Section 4.4.1.
EEA-15	Describe new FAA or Massport security requirements that could affect the environment	Security projects are described in Section 4.4.3. Security fencing has been replaced due to it reaching its useful life. Besides fencing, no security projects are expected to affect the environment.
EEA-16	Planning initiatives undertaken by the Hanscom AFB, MMNHP, and four host towns that have an affect or are affected by Hanscom Field	Planning activities at MMNHP are described in Section 4.2.4.1, at Hanscom AFB in Section 4.2.4.2, and the four towns in Section 4.2.3.
EEA-17	Discuss status of Federal Interagency Group discussions	The federal interagency workgroup is described in Section 10.13.2. The group has not formally convened in recent years.
Regional Transportation Context		
EEA-18	Hanscom's role in regional transportation and efforts by Massport to coordinate with other agencies	Hanscom's central role as New England's premier GA airport is described in Section 5.3.
EEA-19	2012 status report on regional transportation system	A status report on the regional transportation system is discussed in Chapter 5 which covers aviation in Sections 5.4 and 5.5, Rail in Section 5.8, and Ground Access Improvements in Section 5.9.
EEA-20	Report on recent rail initiatives and potential effects on Hanscom passenger travel	Recent rail initiatives are discussed in Section 5.8.
EEA-21	Role of Logan	The role of Logan is described in Section 5.3.2.
EEA-22	Diversion opportunities to other airports and other modes	Diversion opportunities to other airports are described in Section 5.4 and 5.5, and other modes in 5.8 (Rail).
EEA-23	Report on integration of the New England Regional transportation	Integration of the New England Regional Transportation Plan is described among the various long range planning efforts in Section 5.7.
EEA-24	Status of ground access improvement at New England airports	The status of ground access improvements at New England Airports is described in Section 5.9.
EEA-25	Update on Massport's efforts to promote service at Worcester and other airports	Efforts to promote service at Worcester and other airports are covered in Section 5.9.2 and 5.9.3.
EEA-26	Report on relevant regional and local highway and transit projects	Regional and local highway and transit projects are described in Section 6.2.
Ground Transportation		
EEA-27	Report on 2012 ground transportation conditions including contribution of Hanscom Field to baseline	Hanscom Field is an off-peak generator, meaning that peak traffic for Hanscom Field does not coincide with more general peak traffic in the area. Hanscom-related traffic contributed only four percent of total traffic along Route 2A in 2012. See Section 6.4.
EEA-28	Show how Massport is working with the Hanscom AFB and other abutters on TDM	Massport has begun to collaborate with ground transportation coordinators at the AFB to provide information about TDM programs to employees and students working at Hanscom Field. Beginning in the winter of 2014, Massport and the AFB, in partnership with MassRIDES, will co-host a Transportation Fair on Hanscom Field to promote carpools, vanpools and available reward programs. See Section 6.6.2.
EEA-29	Update on Hanscom employee survey	A commuter survey of Hanscom employees was conducted in 2013 and is summarized in Section 6.4.1.1 with data provided in Appendix C.
EEA-30	Describe TMA opportunities	Massport has been exploring various TMA opportunities which are described in Section 6.6.2.5.
EEA-31	Summarize existing metropolitan transportation documents	Transportation planning is detailed in Section 6.3.
EEA-32	Assess potential affects from considered non-aviation development (such as the Air and Space Museum)	The potential affects from non-aviation development was programmed into future traffic forecasts as presented in Section 6.5.
Noise		
EEA-33	Present 2012 conditions and report historic trends	Noise levels at Hanscom Field decreased over the

Number	Comment	Response
		last several years, due primarily to quieter and better performing aircraft and decreases in operations. In addition, operational changes to the Fly Friendly Program which has reduced the number of touch-and-go flights over the MMNHP and nearby residences has also had a positive impact. See Section 7.6.
EEA-34	Report projected levels for future planning years based on activity forecasts	Noise levels for the planning years of 2020 and 2030 are presented in Section 7.8. 2020 levels will increase from 2012 levels, but are calculated to be lower than 2005 with 2030 levels being slightly lower than 2005.
EEA-35	Report any recent changes in INM	Massport upgraded to version 7.0c for noise calculations in the 2012 ESPR and for new calculations of EXP. See Section 7.5.3.
EEA-36	Address engine run-ups and APUs/GPUs	Massport has well-defined procedures for aircraft engine maintenance run-up and use of APUs/GPUs for Hanscom Field to minimize noise impacts. See Sections 7.4.1 and 7.4.2., respectively.
EEA-37	Consider ground monitoring of noise "hot spots" where complaints are common	The existing monitoring and modeling program provides an accurate representation of noise conditions at Hanscom. Elevated levels as would be expected are experienced near the runway ends. Massport will continue to work with stakeholder to minimize impacts of noise in accordance with the Hanscom Master Plan and Regulations.
EEA-38	Present data from six permanent monitoring locations including minimum, maximum, and average daily DNL	Data is presented in Appendix C.
EEA-39	Compare actual and predicted noise levels	Measured versus modeled noise is presented in Section 7.6.2.
EEA-40	Describe Noise Workgroup abatement measures that have been implemented and their effectiveness	The status of noise workgroup abatement measures is described in Section 7.3 and listed in Tables 7-2 and 7-3.
EEA-41	Include an acoustical treatment to reduce noise impacts in engine run-up areas	An acoustical treatment to reduce noise impacts in the engine run-up area is not feasible. Potential impacts from run-ups have been minimized by relocating a portion of them to the East Ramp.
EEA-42	Report on Fly Friendly Program	In 2009, Massport instituted changes in the Fly Friendly Program to minimize flights over the MMNHP and nearby residential areas. See section 7.8.5.
EEA-43	Status of noise mitigation recommended on 2005 Certificate at Wheeler-Meriam House, and proposal for other sites	Noise mitigation has been achieved through implementation of changes to the Fly Friendly Program.
EEA-44	Impacts of aircraft noise on wildlife and visitors at MMNHP and GMNWR	Noise levels at MMNHP and Great Meadows National Wildlife Refuge (GMNWR) are reported for 2005 and 2012 levels. They show a decrease in noise impacts since 2005. See Table 10-1.
EEA-45	Describe the MMNHP Soundscape Plan	The NPS continues to draft the Soundscape Plan. Data collected by the NPS Natural Sound office was collected in 2008-09 and draft results have been provided for information purposes.
Air Quality		
EEA-46	2012 levels and forecast for future years	Emissions for 2012 are reported in Section 8.3.9 and Table 8-8. Future emissions are presented in Section 8.3.13. These emission calculations demonstrate that emissions associated with Hanscom Field activity are a very small fraction of regional emissions. For all scenarios, air quality concentrations will be in compliance with the Massachusetts and National Ambient Air Quality Standards.
EEA-47	Goals and projections for reducing GHG	Goals for the reduction in GHG emissions are described in Section 8.3.3.
EEA-48	Measures to reduce emissions from all on-site sources	Measures to reduce on-site emissions are described in Section 8.4.
EEA-49	Report on efforts to get FBOs to purchase alternative fuels	A discussion of Massport's work with FBO's is presented in Section 8.4.1.

Number	Comment	Response
EEA-50	Federal standards for lead emissions from single piston aircraft and related public health information	A description of federal standards for lead emissions is provided in Section 8.4.6.
EEA-51	Report percentage of current and future fleet using 100LL Avgas	Based on 2013 operations at Hanscom (as of October 2013), there are a total 246 reciprocating (piston) engines requiring 100 LL fuel or 69 percent of the current aircraft count. See Section 8.4.6.1.
EEA-52	Overview of Ultrafine Particulate Matter issues and status of MassDOT's evaluation as outlined in the 2009 Transportation Act	Ultrafine Particulate Matter is summarized in Section 8.4.7.
Wetlands, Wildlife, Water Resources		
EEA-53	Status of wetland resources including vernal pools and perennial streams	Existing wetland resource areas are described in Section 9.4 and shown on Figure 9-1.
EEA-54	Update rare species, Vegetation Management Plan, and Grassland Management Plan	Rare species are discussed in Section 9.7.1. There are four listed species known to occur at Hanscom. The Vegetation Management Plan is discussed in Section 9.8. The Grassland Management Plan is discussed in Section 9.9.
EEA-55	Show GMNWR on all figures	GMNWR is shown and labeled on relevant figures.
EEA-56	Update on stormwater, NPDES, and the SWPPP	An update on stormwater including NPDES and the SWPPP is provided in Section 9.14.
EEA-57	Update on the Shawsheen River restoration work	Status of restoration work on the Shawsheen Basin is described in Section 2.4.5.
EEA-58	Update on water quality monitoring including that for deicing	An update on water quality monitoring is provided in Section 9.16.2.
EEA-59	Report on changes in impervious area from 2005 to 2012 and for future projections	There has been no change in impervious surface cover since 2005. Estimates for changes in impervious surface for planning years 2020 and 2030 are reported in Table 4-9.
Cultural and Historical Resources		
EEA-60	Update on historical and archaeological resources	An update on historical and archeological resources is provided in Section 10.1.
EEA-61	Respond to USFWS concerns about noise impacts on birds and turtles in the Concord Basin	Noise impacts on the GMNWR have decreased since 2005. Massport will continue to work with stakeholders to minimize potential impacts of Hanscom.
EEA-62	Consult with Towns to collect up to date information	Massport met with each of the four town historical commissions to collect up-to-date information. See section 10.4.
EEA-63	Report on activities of the interagency group	Activities of the interagency group are reported in Section 10.13.2.
EEA-64	Describe NPS Soundscape goals and plans	Soundscape goals and plans are described in Section 10.13.1.
EEA-65	Describe how Massport will work with the Massachusetts Department of Agricultural Resources (MADAR) and four communities to protect Massport agricultural land from conversion	Massport's coordination with MADAR is discussed in Section 10.14.9.
Sustainable Development and Environmental Management System		
EEA-66	Describe Massport's Program	Massport's Sustainable Development Program is described in Section 11.2.
EEA-67	Existing practices at Hanscom	Existing sustainability practices are described in Section 11.3.
EEA-68	Recycling	Since the 2005 ESPR, Massport has converted to single-stream recycling, which recycles a wider range of materials than the previous system. Hanscom will be outfitted with larger-capacity containers, which will be wirelessly monitored, reducing unnecessary services. See Section 11.3.5.4.
EEA-69	Toxic reduction	Hanscom Field is a Very Small Quantity generator (< 220 lb/month) of Resource Conservation and Recovery Act (RCRA)-regulated hazardous waste and a Small Quantity generator (< 2,200 lb/month) of Massachusetts regulated hazardous waste. See Section 11.3.5.3.
EEA-70	EMS	In May 2001, Hanscom Field became the first airport

Number	Comment	Response
		in the U.S. to receive ISO 14001 certification through the development and implementation of an EMS. An update on the implementation of the EMS is provided in Section 11.3.1.
EEA-71	Sustainable design associated with future development	Future sustainability efforts are described in Section 11.5.
EEA-72	Conformance to GreenDOT directives and guidelines	The GreenDOT Program and Massport's conformance is described in Section 11.2.4.5.
Environmentally-Beneficial Measures		
EEA-73	List measures with responsible parties and estimated cost	See Table 12-1.
EEA-74	Whether Massport will institute night-time landing surcharge as a penalty for both GA and commercial flights	Massport already institutes landing fees and a nighttime field-use surcharge for night-time operations.
EEA-75	Program to institute higher surcharges for noisier aircraft	This is not a legally feasible program to implement.
EEA-76	Efforts to extend Fly Friendly to commercial flights	Massport will consider a variety of practical measures to minimize noise impacts. Because commercial flights historically represent a very small percentage of overall flights, this is not a measure that is expected to minimize noise, but would be implemented as needed.
EEA-77	Noise attenuation at run-up areas	Noise from run-ups is mitigated by directing a portion of run-ups to the East Ramp and away from sensitive noise receptors.
Office of Niki Tsongas, U.S. House of Representatives, May 11, 2012		
TSO-1	Concerned about Massport's proposed plans to expand private jet infrastructure at Hanscom given its proximity to historic and natural resources and the recent designation of the area as one of the "11 Most Endangered Historic Places in America" by the National Trust for Historic Preservation.	Massport works with local communities and stakeholders to minimize impacts on environmental and cultural resources. The impacts of noise from aircraft activity have decreased over time. Changes in noise from forecasted aircraft activity levels have also been assessed as presented in Chapter 7.
TSO-2	Given the interest of promoting economic development while preserving these resources, the ESPR should analyze proposed plans for expansion based on potential noise impacts to historic landscape.	Massport has evaluated changes in noise associated with planning years of 2020 and 2030. The detailed analysis is provided in Chapter 7, Noise and Chapter 10, Cultural and Historical Resources. No portion of MMNHP is located in the 65 dB contour in 2012 or the planning years of 2020 and 2030. No portion of MMNHP is located in the 55 dB contour in 2012 and 2020 and only 0.4 acres occurs in 2030.
TSO-3	Reiterates the recommendation to use 2010 actual conditions as baseline.	The 2012 Base Year includes data beyond actual/existing conditions that is useful in generating more accurate forecast conditions, including recent activity from 2011/2012, as well as other historical activity for several aircraft types dating back to 1990.
National Park Service, Minute Man National Historical Park, April 20, 2012		
NPS-1	Requests more focus on potential impacts to MMNHP and related non-federal, natural, cultural and archeological resources.	Massport has assessed the potential impacts on MMNHP and cultural resources for 2012 and planning years of 2020 and 2030. This detailed analysis is presented in Chapter 7, Noise and Chapter 10, Cultural and Historical Resources.
NPS-2	States the need to address impacts of increased air traffic noise over the park and ground traffic along the historic Battle Road and other key locations, which result in adverse effects on historical and natural resources and ability of visitors to enjoy park.	Massport prepared a noise impact assessment associated with air traffic over historic Battle Road and other key locations. Ground traffic impacts are analyzed in Chapter 6. Noise from aircraft is assessed in Chapter 7 and Chapter 10. Noise has decreased since 2005 due primarily to technological trends toward quieter and better performing aircraft and decreases in operations as well as changes to touch-and-go patterns adopted in 2009.
NPS-3	Suggests using the changes in aviation activity from 2005 to 2010 ESPR and their environmental impacts as the baseline case, and recommends holding new plans to at or below 2010 impact levels.	The 2012 Base Year includes data beyond actual/existing conditions that is useful in generating more accurate forecast conditions, including recent activity from 2011/2012, as well as other historical activity for several aircraft types dating back to 1990. Future development activities will be reviewed by

Number	Comment	Response
		Federal, State, and local agencies for compliance with applicable environmental laws and regulations. See Chapters 7 and 10.
NPS-4	Draws attention to Massport "L.G. Hanscom Field 2010 Annual Noise Report," which indicates that MMNHP noise levels (at 56.1 dBA) are above EPA speech interference threshold (52 dBA).	The reference to MMNHP noise levels of 56.1 dBA is a DNL measure which is averaged over the time period. The speech interference level of 52 dBA refers to a level when an impact may occur. Because one is an average and the other is an impact threshold, the two numbers cannot be compared to each other. Noise is addressed in further detail in Chapters 7 and 10.
NPS-5	Urges Massport to develop Hanscom within context of a regional transportation plan	Massport agrees with the importance of planning future development at Hanscom consistent with regional transportation. See Chapters 4 and 5 for information on consistency of development plans with regional planning efforts and the regional transportation network.
U.S. Department of the Interior, Fish and Wildlife Service, Eastern Massachusetts National Wildlife Refuge Complex		
FWS-1	Requests better acknowledgement of Great Meadows National Wildlife Refuge (NWR) including marking on maps, a listing in the Glossary of Terms, mention in the local and regional context section, and a description of the significance of Great Meadows in Chapter 10 when discussing Henry David Thoreau and Ralph Waldo Emerson.	Massport has included Great Meadows National Wildlife Refuge (GMNWR) on project figures and addressed specific comments in Chapter 10 including Section 10.14.5.
FWS-2	Concern is expressed regarding noise and lead pollution impacts on wildlife and visitors, particularly at the Concord Impoundment.	Chapter 7 presents an analysis of potential noise for planning years of 2020 and 2030. ESPR Chapter 8, Air Quality explains new Federal standards related to use of lead-based fuel. As shown in Figure 7-9, noise over the Concord impoundment has decreased significantly between 2005 and 2012. The future scenarios suggest that noise would increase in 2020 and 2030 but remain below 2005 levels including over the Concord impoundment (see Figures 7-17 and 7-18).
FWS-3	Concern is expressed that the ESPR does not address noise reduction and provides specific recommendations for revising noise analysis.	Noise impacts and mitigation are discussed in Chapter 7.
FWS-4	Expresses concern regarding lead emissions based on "2008 EPA Report on Lead Emissions from the Use of Leaded Aviation Gasoline in the United States" and requests further testing.	Massport discusses the potential impacts of lead in Chapter 8, Air Quality.
Office of Jay Kaufman, Massachusetts House of Representatives, Lexington District, 5/14/12 (Massport's responses provided in writing)		
KAU-1	Requests clarification regarding use of single or multiple scenarios for forecast conditions and recommendation for use of one "realistic" scenario.	As directed in the MEPA scope, a single "moderate growth scenario" has been used for forecasting future aviation activity. A single forecast has been generated for both 2020 and 2030.
KAU-2	Expresses concern regarding use of different base years for each ESPR, for the reason that it reduces ability to measure cumulative impact.	The ESPR is a planning document, not a permit application. The ESPR has been prepared to include noise contours for the 2012 Base Year, and the 2020 and 2030 Forecast Conditions. These results are compared with historical contours from 2000, and 2005.
KAU-3	Asks whether Massport would perform lead monitoring studies at Hanscom due to community concerns and anticipated Federal standards.	ESPR Chapter 8, Air Quality describes the new Federal standards and includes a table illustrating current and future fleet use of lead-based fuel. Federal guidance targets study at other airports where it considers lead risks to be greater, therefore site specific studies at Hanscom are not warranted at this time.
KAU-4	Air Quality: Asks whether Massport would perform ultra-fine particulate matter monitoring studies at Hanscom due to community concerns and Federal standards.	ESPR Chapter 8, Air Quality describes ultra-fine particulates as well as requirements of the Transportation Reform Act of 2009.
Massachusetts Division of Fisheries and Wildlife, Natural Heritage & Endangered Species Program, May 15, 2012		

Number	Comment	Response
ESP-1	Requested that proposed scope for ESPR include mapping of Natural Heritage & Endangered Species Program (NHESP) as "Priority Habitat for state-listed grassland bird species.	Priority habitat of state listed species is included in Chapter 9.
Metropolitan Area Planning Council, April 20, 2012		
MPC-1	Requests that Massport address concerns related to lead emissions as reported in the EPA's 2008 report on lead emissions for aviation gasoline in the ESPR.	Massport included a discussion of potential impacts of lead emissions from aviation gasoline in Chapter 8, Air Quality.
Save Our Heritage, April 19, 2012		
SOH-1	Notes designation of historic and natural resources surrounding Hanscom as "Last Chance Landscape" (Scenic America) and "11 Most Endangered Historic Places in America" (National Trust for Historic Preservation). These issues are unresolved and the ESPR is an opportunity to address them.	Massport recognizes the importance of the environmental and cultural resources in the area surrounding Hanscom and supports the use of the ESPR in presenting existing conditions and minimizing impacts. See Chapter 10, Cultural and Historical Resources.
SOH-2	Lists historic and natural resources in the region and describes their importance.	Historic and natural areas are evaluated as part of the ESPR in Chapter 10.
SOH-3	Reminds Massport to "honor the 1978 Master Plan that stipulates a 30 seat limit for commuter aircraft and excludes certificated passenger service."	Massport's Master Plan and Noise Rules permit scheduled commercial passenger services with aircraft having not more than 60 seats, the current definitional size limit of commuter aircraft.
SOH-4	States that 1980 noise rules do not supersede 1978 Master Plan so Massport must comply with both by complying with the lower number of seats (30 rather than 60).	See response to SOH-3.
SOH-5	Encourages a single scenario scope that holds impacts at 2010 levels, implements an innovative plan to further mitigate all fleet-mix impacts, and complies with the Minute Man Park Soundscape Plan and the recommendations of the Federal Interagency Working Group charged with the mission to develop long-term protection goals for the Park and environs.	The 2012 Base Year includes data beyond actual/existing conditions that is useful in generating more accurate forecast conditions, including recent activity from 2011/2012, as well as other historical activity for several aircraft types. Massport will continue to work with stakeholders in minimizing impacts and ensuring compliance with Federal, state and local environmental laws and regulations. See Chapter 3, Activity Levels.
SOH-6	Airport Activity Levels - 2012 Hanscom ESPR should exclude study of additional commercial and cargo operations because Massport can facilitate these "limitations" via a multi-airport sponsorship; additionally, Massport should simultaneously prepare an ESPR for Worcester airport.	Cargo is not included in the forecasted scenario at this time. A modest level of commercial operations consistent with Massport Policy is included for the planning years 2020 and 2030. ESPR documents are prepared for both Boston Logan and Hanscom. Regional concerns, including issues related Worcester Airport, are summarized in Chapter 5, Regional Transportation.
SOH-7	Airport Planning - Emphasizes holding impacts to 2010 levels; recommends adherence to Minute Man National Historical Park Soundscape Plan; recommends investigating/implementing take-off and landing procedures at higher altitudes to reduce local noise impacts.	To ensure that the ESPR is as current as possible, the 2012 year is presented as a baseline. Aircraft activity levels are forecast for planning years of 2020 and 2030 based on a reasonable assessment of market demand. Massport will work with the local communities and stakeholders to minimize impacts of operations and associated airfield improvements including discussions about the MMNHP Soundscape Plan once it is produced. Massport will continue to follow take-off and landing procedures governed by criteria set by the FAA to ensure aviation safety and minimize potential impacts on the ground.
SOH-8	Landside Planning - Recommends establishing a "permanent boundary footprint" for Hanscom to ensure preservation of boundaries with adjacent resources.	Massport's activities are confined to the property boundary at Hanscom and any required modifications to adjacent properties to protect aviation safety in accordance with Federal Aviation Administration.
SOH-9	Traffic Impacts of Non-Active Aviation Development - Recommends evaluation of proposed Air and Space Museum for adverse traffic impacts to surrounding area, as well as flight operations due to air shows and performances.	Potential traffic impacts of the proposed Air and Space Museum are presented in Chapter 6, Ground Transportation.
SOH-10	Regional Transportation Context – the Hanscom expansion contradicts multi-airport transportation program, "as evidenced by the MAC study of	Hanscom is an important component of the regional transportation network as evidenced by "Massachusetts Statewide Airport Economic Impact

Number	Comment	Response
	Massachusetts GA Airports."	Study" prepared by the Massachusetts Department of Transportation Aeronautics Division. It states that Hanscom's contributes \$249 million to the state economy. See Chapters 3, Activity Levels, and 5, Regional Transportation Context.
SOH-11	Ground Transportation – development scenarios proposed in the ESPR should not increase traffic on Historic Battlefield Road.	Hanscom currently contributes 4% of traffic levels on Battle Road. That could rise to 5% in 2020 and 7% in 2030 assuming the increase in airport activity forecasted. Much of the traffic impact is associated with regional economic development and commuter patterns. See Table 1-4 and Chapter 6, Ground Transportation for more information.
SOH-12	Noise - the primary noise metric should be "Time Above (TA)" metric; additionally, suggests that MEPA require Massport to conduct a noise health assessment study of residents living under flight paths.	A number of supplemental noise metrics are presented for consideration. Only the 65 DNL has a regulatory implication. A historic review of noise impacts shows that noise has decreased overtime. See Chapter 7.
SOH-13	Air Quality - the 2012 ESPR must include lead in its air quality assessment.	Lead is addressed in Chapter 8, Air Quality.
SOH-14	Wetlands/Wildlife/Water Resources - States that lead measurements should be done by independent source.	Lead is addressed in Chapter 8, Air Quality.
SOH-15	Cultural and Historic Resources - Reminds Massport of Federal Interagency MOU to coordinate long-term preservation of area surrounding Hanscom due to its unique proximity to historical resources, as well as "Hanscom at Crossroads" document requesting moratorium on all new development until establishment of regional multi-modal transportation plan.	Massport recognizes the cultural and historic importance of the Hanscom area and will continue to work with the local communities and regional stakeholders in the planning and operation of Hanscom. See Chapter 10, Cultural and Historical Resources.
SOH-16	Sustainability - Reminds Massport that "sustainability" refers to environment and not just finances.	Massport has conducted a number of sustainability programs that reduce environmental impact and provide long-term cost savings. See Chapter 11.
Hanscom Area Towns Committee, Environmental Subcommittee 4/4/12 (Massport's responses provided in writing)		
HAT-1	Asks about parallel ESPR process for Worcester airport and incorporation of three airport regional system into ESPR scenario development and evaluation.	ESPR documents are prepared for both Boston Logan and Hanscom. Regional concerns, including issues related Worcester Airport, are summarized in Chapter 5, Regional Transportation.
HAT-2	Asks about rational basis for use of 2012 as Base Year versus 2010 Actual Conditions (preferred by HATS).	The 2012 Base Year includes data beyond actual/existing conditions that is useful in generating more accurate forecast conditions, including recent activity from 2011/2012, as well as other historical activity for several aircraft types dating back to 1990. See Chapter 3, Airport Activity Levels.
HAT-3	Asks about whether Base Year will account for actualization of 2005 forecast operations, as well as recommendations from Inter-agency Workgroup for protection of Minute Man Historical Park.	See response to HATS-2 above. Massport will also consider any recommendations from the Workgroup, however, at the time of writing, it was no longer active.
HAT-4	Reiterates recommendation for using 2010 actual conditions as baseline, asking for agreement.	See response to HATS-2 above.
HAT-5	Asks about conformance to MassDOT GreenDOT directives.	Massport is implementing a number of GreenDOT sustainability directives at Hanscom that mirrors GreenDOT goals, as well as Smart Growth regional planning considerations. See Chapter 11, Sustainable Development and Environmental Management System.
HAT-6	Asks about ESPR commitments related to monitoring and reducing lead emissions.	A summary of the status of the proposed Federal lead emission reduction program is presented in Chapter 8, Air Quality.
HAT-7	Asks whether ESPR would account for particulate matter in response to Transportation Health Act of 2009 and whether it would fund or study health effects.	Air quality reporting includes PM10 and PM2.5 particulate matter. See Chapter 8, Air Quality.
HAT-8	Asks about sufficient noise contour analysis to accurately assess annoyance and disturbance levels.	Noise contours for a number of planning scenarios are included in Chapter 7, Noise.
ShhAir, April 3, 2012		
Shh-1	Commits to active participation in the scoping process	Massport appreciates the participation

Number	Comment	Response
	for the Hanscom ESPR.	
Shh-2	Explains the strong community opposition to Hanscom expansion efforts in the past, reflecting stewardship of the area as unique in American history, as well as for environmental integrity.	Massport recognizes the important environmental and cultural resources and the importance of the ESPR in minimizing impacts.
Shh-3	Requests "good faith" collaboration between Massport and HATS ES in developing the ESPR scope.	Massport recognizes the importance of working with local communities and stakeholder organizations in the development of the ESPR.
Neighborhood Liaison for Concord Homes, May 7, 2012		
NLC-1	Provides detailed description of impact from Hanscom aircraft operations on daily life, due to noise and air quality disturbances, stated within the context of working to develop a "full, thorough, and open" ESPR.	Massport appreciates public comments on local effects of Hanscom operations. See Chapter 3, Airport Activity Levels, Chapter 7, Noise, and Chapter 10, Cultural and Historical Resources.
NLC-2	Chief concern: emission of fumes, especially from aircraft using lead-based fuel, with particular impact on children.	Massport has assessed potential effects from lead in Chapter 8, Air Quality.
NLC-3	Secondary concern: noise impact on families; states disagreement with FAA FONSI for plans to expand hangar capacity for storage and service of private jet aircraft; believes DNL 65 dB standard for incompatibility with residential land use is impractical; states that FAA/Massport have not performed noise testing on actual residential properties.	Noise impacts are assessed in Chapter 7. A variety of supplemental metrics are provided to understand potential effects.
NLC-4	Current and future scenarios for Hanscom Field should not exceed the 2010 baseline and impacts should be mitigated from 2010 levels down.	The 2012 Base Year includes data beyond actual/existing conditions that is useful in generating more accurate forecast conditions, including recent activity from 2011/2012, as well as other historical activity for several aircraft types dating back to 1990.
NLC-5	A permanent boundary footprint should be established to limit incremental expansion at Hanscom Field (such as Massport's recent bid to purchase new airside Naval property).	Massport appreciates the comments from the public.
NLC-6	Massport should use the 30-seat limit for passenger aircraft noted in the Master Plan, not the 60-seat limit noted in the Noise Regulations.	See response to SOH-3 above
NLC-7	No new commercial or cargo service should be studied in current or future scenarios.	Cargo is not included in future forecasts at this time. A modest increase in commercial operations consistent with Massport Policy is forecasted in the planning years based on expected demand.
Belinda Gower, April 4, 2012		
Bel-1	Expresses frustration with continued increase in air traffic and pollution generated by Hanscom, with particular concern for three young children.	Massport appreciates comments from the public. Information on aircraft activity shows that operations have decreased in recent years. See Chapter 3, Airport Activity Levels, Chapter 7, Noise, and Chapter 8, Air Quality.
Bel-2	Explains discomfort and stresses of living under flight path, including reports of neighbors moving away and health impacts like cardiovascular disease (e.g., hypertension, stroke).	Massport appreciates the comments from the public.
Bel-3	Requests that MEPA "take this environmental scoping process very seriously and request stringent measurements of lead, particulates, CO ₂ equivalent, and noise contours" and that "all unhealthy impacts be mitigated thoroughly and appropriately."	Massport is complying with MEPA's requirements as directed in its scope for the 2012 ESPR.
Walden Woods Project, May 8, 2012		
WAL-1	Explains that the primary impact from Hanscom on Walden Woods is interruption to outdoor education programs due to the inability of students and teachers to adequately hear presenters, degrading the 18th and 19th century experience.	Massport has included an assessment of noise impacts in Chapter 7.
WAL-2	States concern that proposed scope of ESPR is too open-ended, with ability for Massport to make decisions based on market demands.	Massport works with the local communities and stakeholders to assess current impacts of future development in a manner that is consistent with Massport's mission to provide air transportation.
WAL-3	Explains that previous expansions in operations have	A historical perspective on aircraft activity levels is

Number	Comment	Response
	resulted in increased noise, degrading Walden Woods experience; thus, further increases of up to twice current capacity would further degrade the recreational and educational benefits.	presented in Chapter 3, Airport Activity Levels and it shows that operations have decreased in recent years.
WAL-4	Current and future scenarios for Hanscom Field should not exceed the 2010 baseline and impacts should be mitigated from 2010 levels down.	See responses to HATS comments.
WAL-5	A permanent boundary footprint should be established to limit incremental expansion at Hanscom Field (such as Massport's recent bid to purchase new airside Naval property).	See responses to HATS comments.
WAL-6	Massport should use the 30-seat limit for passenger aircraft noted in the Master Plan, not the 60-seat limit noted in the Noise Regulations.	See responses to HATS comments.
WAL-7	No new commercial or cargo service should be studied in current or future scenarios.	See responses to HATS comments.
Concord Museum, May 9, 2012		
MUS-1	Explains that the primary impact from Hanscom on the Concord Museum is interruption to outdoor education programs due to the inability of students and teachers to adequately hear presenters, degrading the 18th and 19th century experience.	Massport has included an assessment of noise impacts in Chapter 7.
MUS-2	States concern that proposed scope of ESPR is too open-ended, with ability for Massport to make decisions based on market demands.	Massport works with the local communities and stakeholders to assess current impacts and plan future development in a manner that is consistent with Massport's mission to provide air transportation.
MUS-3	Explains that previous expansions in operations have resulted in increased noise, degrading Walden Woods experience; thus, further increases of up to twice current capacity would further degrade the recreational and educational benefits.	A historical perspective on aircraft activity levels is presented in Chapter 3, Activity Levels and it shows that operations have decreased in recent years. Projected levels would be below historical peaks.
MUS-4	Current and future scenarios for Hanscom Field should not exceed the 2010 baseline and impacts should be mitigated from 2010 levels down.	See responses to HATS comments.
MUS-5	A permanent boundary footprint should be established to limit incremental expansion at Hanscom Field (such as Massport's recent bid to purchase new airside Naval property).	See responses to HATS comments.
MUS-6	Massport should use the 30 seat limit for passenger aircraft noted in the Master Plan, not the 60-seat limit noted in the Noise Regulations.	See responses to HATS comments.
MUS-7	No new commercial or cargo service should be studied in current or future scenarios.	See responses to HATS comments.

Table A-2 Comment Letters with Response Identifiers

L.G. Hanscom Field — 2012 Environmental Planning and Status Report

Comment Received

	Commenter	Date of Letter/Email	Contact Information	Massport Comment Response Identifiers
1.	Richard Sullivan, Secretary of Energy and Environmental Affairs, Commonwealth of Massachusetts	5/18/2012	Richard K. Sullivan, Jr. Office of Energy and Environmental Affairs 100 Cambridge St, Suite 900 Boston, MA 02114	EEA-1 – EEA-77
1.	Niki Tsongas, Member of Congress John F. Kerry, United States Senator	5/11/2012	Niki Tsongas, Member of Congress John F. Kerry, United States Senator Congress of the United States Washington, DC 20515	TSO-1 – TSO-3
2.	U. S. Department of the Interior, National Park Service, Lou Sideris, Chief of Planning and Communications	4/20/2012	Lou Sideris Chief of Planning and Communications Minute Man National Historical Park 174 Liberty Street Concord, MA 01742	NPS-1 – NPS-5
3.	U. S. Department of the Interior, Fish and Wildlife Service, Elizabeth A. Herland, Project Leader	4/20/2012	Elizabeth A. Herland Project Leader U. S. Department of the Interior, Fish and Wildlife Service Eastern Massachusetts National Wildlife Refuge Complex 73 Weir Hill Road Sudbury, MA 01776	FWS-1 – FWS-4
4.	Jay Kaufman, Commonwealth of Massachusetts, House of Representatives	05/14/12 (to Massport)	Representative Jay Kaufman District Lexington State House, Room 34 Boston, MA 02133 Phone: 617-722-2320 Email: Jay.Kaufman@mahouse.gov	KAU-1 – KAU-4
5.	Jay Kaufman, Commonwealth of Massachusetts, House of Representatives	05/15/12 (to MEPA)	Representative Jay Kaufman District Lexington State House, Room 34 Boston, MA 02133 Phone: 617-722-2320 Email: Jay.Kaufman@mahouse.gov	KAU-1 – KAU-4
6.	Natural Heritage & Endangered Species Program Massachusetts Division of Fisheries and Wildlife,	4/20/2012	Everose Schluter, PhD Endangered Species Review Biologist Natural Heritage & Endangered Species Program Massachusetts Division of Fisheries and Wildlife 1	ESP-1

	Everose Schluter, PhD		Rabbit Hill Road Westborough, MA 01581 Voice: (508) 389-6346 Fax: (508) 389-7891	
7.	Metropolitan Area Planning Council (MAPC), Marc Draisen, Executive Director	4/20/2012	Marc Draisen Executive Director 60 Temple Place Boston, MA 02111 617-451-2770	MPC-1
8.	Save Our Heritage, Anna West Winter, Executive Director	4/19/2012	Anna West Winter, Executive Director Save Our Heritage 57 Main Street Concord, MA 01742 978-369-6662 Fax 978-369-6712 anna@saveourheritage.com	SOH-1 – SOH-16
9.	Hanscom Area Towns Committee Environmental Subcommittee (HATS ES), Richard Canale	4/4/2012	Richard Canale Hanscom Area Towns Committee Environmental Subcommittee (FIATS ES) Town Offices Town of Lexington Lexington, MA 02421 r.canale@rcn.com 781-861-0287	HAT-1 – HAT-9
10.	ShhAir, Margaret Coppe, President, ShhAir Board	4/3/2012	Margaret Coppe President, ShhAir Board 12 Barrymeade Drive Lexington, MA 02421 781-862-2637	Shh-1 – Shh-3
11.	Neighborhood Liaison for Concord Homes Lynn Vanacore Bloom	5/7/2012	Lynn Vanacore Bloom Neighborhood Liaison for Concord Homes 25 Fuller Lane Concord, MA 01742 lbloom1978@aol.com	NLC-1 – NLC-7
12.	Belinda Gower	4/4/2012	Belinda Gower 63 Cedar Way Concord, MA 01742 978-254-5915 bgower@mac.com	Bel-1 – Bel-3
13	The Walden Woods Project	5/8/2012	Kathi Anderson Executive Director 44 Baker Farm Lincoln, MA 01773-3004	WAL-1 – WAL-7
14	Concord Museum	5/9/2012	Peggy Burke Executive Director 200 Lexington Road PO Box 146 Concord, MA 01742-0146	MUS-1 – MUS-7



The Commonwealth of Massachusetts
Executive Office of Energy and Environmental Affairs
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May 18, 2012

CERTIFICATE OF THE SECRETARY OF ENVIRONMENTAL AFFAIRS
ESTABLISHING THE SCOPE FOR THE
2012 L. G. HANSCOM FIELD ENVIRONMENTAL STATUS AND PLANNING REPORT

PROJECT NAME	: 2012 Hanscom Field Environmental Status and Planning Report
PROJECT MUNICIPALITY	: Bedford, Concord, Lexington, and Lincoln
PROJECT WATERSHED	: Shawsheen River
EEA NUMBER	: 5484/8696
PROJECT PROPONENT	: Massachusetts Port Authority (Massport)
DATE NOTICED IN MONITOR	: March 7, 2012

As Secretary of Environmental Affairs, I hereby establish the scope for analysis to be presented in the 2012 Hanscom Field Environmental Status and Planning Report (ESPR). In accordance with the provisions of 301 CMR 11.00 and 11.09 governing Special Review Procedures, this ESPR process was established by the proponent and this office to replace the 1995 Update to the Generic Environmental Impact Report (GEIR).

Project Description

Hanscom Field comprises approximately 1,300 acres of land, located approximately 20 miles northwest of Boston, within the municipalities of Bedford, Concord, Lexington, and Lincoln. Since 1974, when Massport assumed ownership of the field, it has primarily accommodated private general aviation (GA) activity, commercial, and cargo service. The Federal Aviation Administration (FAA) identifies Hanscom Field as a reliever airport to Logan Airport, whereby Hanscom Field provides substantial airside relief by annually serving approximately 164,000 GA operations. Hanscom Field also has supported limited commercial air service.

The ESPR inventories Hanscom's facilities and infrastructure, summarizes Massport's tenant audit program, identifies airport activity levels, describes ground transportation, explains Massport's Environmental Management system, and provides information on Hanscom's planned role in the future regional transportation system and its 5-year projected improvement program. It also examines noise and air quality levels under existing and a future scenario, and identifies cultural, historic, conservation and recreational resources.

History and Purpose of ESPR

Since the 2000 ESPR, Massport has provided in both ESPRs (2005 ESPR) a retrospective analysis of past trends in the environmental impacts of Hanscom Field and analyses for future conditions. As a result, these documents remain an effective planning tool from which the Massport's policy and program developments are derived. The 2012 ESPR should present an overview of the operational environment and planning status of Hanscom Field and should provide long-range projections of environmental conditions against which the effects of future individual projects can be compared. The ESPR should allow for the review of historical environmental information, current information, and the forecast of the future environmental effects at Hanscom Field.

The ESPR does not replace the MEPA review of specific projects at Hanscom that meet or exceed regulatory thresholds, with the exception of routine maintenance and replacement projects. For each project-specific review, Massport would be required to perform an individual analysis of impacts and mitigation (for those projects that require a stand-alone EIR and Section 61 Findings). The ESPR serves as a vehicle for ensuring that long-term, broad-scope planning informs the review and implementation of individual actions at Hanscom Field.

The Proposed Scope for the 2012 ESPR was submitted by Massport. While I have used that scope as a framework for this Certificate, I have modified it based on the 2005 ESPR Scope, in response to the comments received, and internal EEA review. Therefore, this scoping certificate is the governing document for the contents of the 2012 ESPR.

2012 ESPR Outline

The 2012 ESPR should follow the general format of the 2005 ESPR. Detailed technical studies should be summarized in a readable format to illustrate clearly the implications of recent trends, existing conditions and potential future scenarios. The 2012 ESPR should use the base information developed for the 2005 ESPR, present policy considerations and an overview of the airport's current and potential future role within the regional planning context, and include a status report on the Massport's proposed planning initiatives and projects. The 2012 ESPR's technical studies should include an analysis of airport activity levels, noise, ground access, air quality, water quality, and sustainability.

The chapters on ground transportation management, noise, air quality, and wetlands/water resources should include the following sections:

- Discussion of analysis methodologies and assumptions.
- Report on 2012 conditions in comparison to trends from previous years, at least since 2000 (historical trends are most valuable when traced back 10 or 15 years, where the data is available).
- Prediction of 2020 and 2030 conditions, based upon the growth scenario described in Section III below.

SCOPE

Executive Summary

The Executive Summary should provide a summary of the major chapters of the ESPR, with supporting graphics and data tables. It should be made available as a separate document to facilitate wider distribution, including publication on Massport's web site.

I. Introduction

This chapter should introduce the 2012 ESPR and place it in its environmental and regulatory context. This section should:

- Summarize the evolution of the Hanscom Field environmental review process.
- Describe the analytical framework for the environmental reporting and technical studies to be conducted.
- Describe the organization of the 2012 Hanscom Field ESPR.

II. Facilities and Infrastructure

This chapter should update the information that was presented in the 2005 ESPR regarding the airfield and its supporting infrastructure and utility systems, including:

- The use and storage of hazardous materials at Hanscom Field, including jet and leaded fuel storage and spill prevention efforts. EEA-1
- Report on any deficiencies in the water and wastewater distribution systems for Hanscom facilities, which connect to the Massachusetts Water Resources Authority (MWRA) system at the Air Force Base. EEA-2
- Identify changes in water demand and wastewater generation at Hanscom facilities for 2005 to 2012, and projections for water use and wastewater flow for 2020 and 2030. EEA-3
- Identify Massport's water conservation measures for equipment, plumbing, and landscape irrigation at Hanscom. EEA-4
- Identify Infiltration/Inflow removal proposed for the MWRA wastewater system and report it in section XII. EEA-5
- The status of Massport's tenant audit program. EEA-6

- The current status of 21E sites at Hanscom Field.

EEA-7

This section should also contain information on the size and use of all existing structures and parking areas (including the number of spaces).

EEA-8

III. Airport Activity Levels

The 2012 ESPR should report on airport activity levels for 2005 to 2012 and describe the new growth forecasts of aviation activity for 2020 and 2030. This section is based on aviation growth forecasts done for all three Massport airports; Logan, Hanscom, and Worcester. The ESPR should use these forecasts to assist in developing fleet projections for each future analysis year. Historic airport activity levels should be described. The ESPR should explain the process a commercial airline must follow to commence service at Hanscom. It should provide an update of activity levels at Hanscom Field according to the following:

EEA-9

EEA-10

EEA-10

EEA-11

- Report on aircraft fleet mix and on activity levels of GA, commuter, and military operations from 2005 to 2012.
- Compare 2005-2012 activity levels to historic trends.
- Compare actual 2012 activity levels to forecasted 2010 activity levels from the 2005 ESPR.
- Report on current and future trends within the airline industry.

The ESPR should utilize growth forecasts developed for aviation activity for 2020 and 2030 based on recent trends at Hanscom Field and with consideration of the role that the airport plays in the regional airport system. The ESPR should report actual changes in fleet mix and aircraft operations at Hanscom Field – both increases and decreases – and compare this data to the range of future activity levels and fleet mix defined by the moderate growth scenarios of the 2005 ESPR. The new growth forecasts should incorporate lower annual growth assumptions compared with those used in the 2005 ESPR forecasts. Differences between actual and previously forecast activity levels should be explained and should be reflected in the underlying assumptions for the 2020 and 2030 forecasts. The forecasts should also include coordination with forecasting for the Logan ESPR and the development of forecasts for the New England regional aviation system.

Each forecast year should use a moderate growth scenario that will vary the fleet mix. The fleet mix of the moderate growth scenario should be comparable to the existing conditions, which include GA, military, and commuter service consistent with the 1978 Master Plan and the 1980 Noise Rules. This scenario should be based on recent trends at the airport as well as regional and national aviation trends. The ESPR should provide future aviation forecasts according to the following:

- Prepare a 2020 growth scenario for activity levels and passenger forecasts.
- Prepare a growth scenario for activity levels that vary the fleet mix and passenger forecasts for the year 2030, which is consistent with the Logan ESPR and other regional planning efforts.

The 2012 ESPR should consider the effects of federal military base closings on military activity levels at Hanscom Field.

EEA-12

IV. Airport Planning

The 2012 ESPR should assess Massport's planning strategies for operating an efficient airport in an environmentally sensitive manner. As owner and operator of Hanscom Field, Massport must accommodate and guide airport tenant development. The ESPR should describe the status of planning initiatives and projects for the:

- Terminal Area
- Airside Area
- Landside Area

EEA-13

The ESPR should identify and describe each project contained in Massport's five-year capital improvements program, and identify which, if any, of these projects may require individual MEPA review. The ESPR should describe any new FAA or Massport security policies that would affect environmental impacts relating to physical facilities or airfield operations.

EEA-14

EEA-15

This section should also report on planning and development initiatives by the Minute Man National Historical Park (MMNHP), the Hanscom Air Force Base, and the four contiguous towns that affect Hanscom Field and are affected by Hanscom Field. It should discuss the Federal Interagency Group, and its deliberations regarding Hanscom Field.

EEA-16

EEA-17

V. Regional Transportation Context

The 2012 ESPR should describe the role of Hanscom Field in the region's transportation system, and report on Massport's efforts to strengthen the regional transportation system and its cooperative efforts with other transportation agencies to promote an efficient regional aviation system with improved public/private transportation access. It should draw upon and update information provided in the most recent Logan ESPR Update in relation to Hanscom Field and include the following:

EEA-18

- Hanscom Field's role in the GA airport network.
- For 2012, a report on regional airport operations, passenger activity levels, and the status of plans and new improvements as provided by regional airport authorities and a report on recent rail service initiatives by others that could affect air passenger travel, including Acela (rail) Service and bus service.
- The role that Logan International Airport plays in intercity travel choices.
- Diversion opportunities to alternative modes and to other New England airports.
- A report on the integration of New England regional airport facilities as a regional system.
- The current status of the ground access improvements at the four New England regional airports (Logan International Airport, T. F. Green Airport, Manchester Airport, and Worcester Regional Airport) by state transportation agencies, including projected dates

EEA-19

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for completion of studies and/or construction and an analysis to quantify the effects of these measures upon projected passenger levels at each of the airports.

- A report on the Massport's efforts to promote service at Worcester and other airports. EEA-25
- A report on relevant regional and local highway studies and transit projects. EEA-26

VI. Ground Transportation

The 2012 ESPR should report on Ground Transportation conditions using the following indicators: EEA-27

- Traffic, roadway and access analysis results.
- Mode share data.
- High occupancy vehicle (HOV) ridership alternatives.
- Alternative transportation modes; availability and use.
- Parking inventory, demand and management information.

The traffic analysis should be done in accordance with the EEA/MassDOT Guidelines for Traffic Impact Assessment. Background growth in traffic within the study area attributed to Hanscom Field as compared to other area sources will be evaluated. The study area for the traffic analysis in the 2005 ESPR was bounded by Route 2A, Old Bedford Road, Route 62, Routes 4/225 and Route 128/I-95. It should be maintained in the 2012 ESPR. The 2012 ESPR should include the fourteen intersections that were counted for the 2005 ESPR within this study area. The ESPR should identify and evaluate those study area intersections at which Hanscom Field traffic contributes 10-percent or more to the existing traffic volumes. The 2012 ESPR should also use this approach to evaluate the study area intersections for the forecast activity levels and years.

The ESPR should show how Massport is developing partnerships with the U.S. Air Force and other abutters and area businesses to facilitate an effective set of regional Transportation Demand Management (TDM) measures. Other special topics should address recent studies, and issues raised in the 2005 ESPR Certificates, reviewers' comments, and: EEA-28

- Report available information from Massport's survey of Hanscom Field employees. EEA-29
- Describe the full range of TDM strategies, including potential for participation in a TMA. EEA-30
- Review, summarize and analyze, as necessary, existing metropolitan transportation documents, and report as to how they relate to Hanscom Field access. EEA-31

The ESPR should also identify the traffic impacts from non-active aviation development, such as an aviation museum, that may occur at Hanscom. EEA-32

VII. Noise

The 2012 ESPR should report current conditions for the year 2012 and projections for the EEA-33

forecast activity levels and years, using the following indicators:

EEA-34

- Noise Exposure (EXP) as calculated in accordance with FAA prescribed standards for the Integrated Noise Model (INM) and past practice at Hanscom Field.
- Day-Night Average Sound Level (DNL) contours (for 55, 60, 65, and 70 decibels (dBA)) and noise locations for approximately 150 sites in the four towns.
- Time-Above (TA) contours (showing 30, 60, and 90 minutes of exposure) for 55 and 65 dBA
- Single Event Level Distribution (SEL/D) metrics, as already incorporated into the annual Noise Report.
- A ranked tabulation of take-off noise levels for different classes of aircraft (used as the basis for SEL/D), and the numbers of operations for each class (on an average daily basis).

All noise contour levels should be computed with the Integrated Noise Model (INM); the DNL levels depicted should be based on accepted EPA and FAA guidelines. Impact assessment for both DNL and TA will be based on data from the 2010 U.S. Census. The basic structure for the TA analysis should follow the protocols developed for the Logan ESPR. The 2012 ESPR should identify any past or current changes in the INM, quantify the effect of modeling changes upon data, and ensure that reporting of past trends is adjusted for such changes. The ESPR should contain an analysis and review for areas that are affected by noise from aircraft upon start-up and take-off roll. The ESPR should address the issue of engine run-ups and the operation of Auxiliary Power Units (APU) and Ground Power Units (GPU). It should consider ground monitoring of noise "hot spots" where complaints are common.

EEA-35

EEA-36

EEA-37

The ESPR should present the noise data from the six permanent monitoring stations at Hanscom Field, including minimum, maximum and average daily DNL values. The ESPR should address the reliability of certain monitoring locations, particularly with respect to background noise levels, and it should compare predicted with actual noise measurements. Special topics should address recent studies, and issues raised in the previous 2005 ESPR Certificate.

EEA-38

EEA-39

In the Beneficial Measures section, the 2012 ESPR should describe the Hanscom Field Noise Workgroup noise abatement measures that have been implemented, and discuss their effectiveness. The 2012 ESPR should include an acoustical treatment to reduce noise impacts in engine run-up areas. It should report on the Fly Friendly program at Hanscom and the recommended "touch and go" procedures over the MFMNHP. In the 2005 FESPR Certificate, the former Secretary recommended noise mitigation be proposed and implemented for the Wheeler-Merriam House in Concord because it was located within the 55dBA DNL contour. Massport should propose noise mitigation measures at other noise sensitive sites that fall within the established noise contours as they change over time. The National Park Service stated that aircraft noise potentially impacts wildlife and visitors to the Great Meadows National Wildlife

EEA-40

EEA-41

EEA-42

EEA-43

Refuge and the Minuteman National Historical Park. ~~The ESPR should describe the Soundscape Plan of the Minuteman National Historical Park, and how aircraft operations at Hanscom affect it.~~

EEA-44

EEA-45

VIII. Air Quality

The 2012 ESPR should report on current conditions for the year 2012, which includes: airport-related greenhouse gases (GHGs), and projections for the forecast activity levels and years using the following indicators:

EEA-46

O Emissions Inventory for:

- Carbon Monoxide (CO)
- Oxides of Nitrogen (NO_x)
- Volatile Organic Compounds (VOCs)
- Particulate matter (PM₁₀ and PM_{2.5})
- Greenhouse Gases (GHG) – CO₂, N₂O, and CH₄

O Available monitoring results for:

- Ozone Precursors
- Nitrogen Dioxide (NO₂)

Massport should set goals and projections in the ESPR for reducing GHG emissions, and the ESPR should identify the base level of GHG emissions for the airport. The 2012 ESPR should report on measures to reduce on-site emissions from all sources, including fuel handling, ground service equipment, and building heating and cooling (see also Section XII). It should report on Massport's efforts to encourage fixed base operators to consider purchasing alternatively fueled vehicles.

EEA-47

EEA-48

EEA-49

The 2012 ESPR should discuss the issue of lead emissions and the establishment of federal standards to control lead emissions from piston engine aircraft. It should discuss the state of the investigations and findings on the public health aspects of leaded aviation fuel. The ESPR should report on the status of the EPA's progress towards rulemaking. It should provide for the percentage of current and future aircraft fleets operating on aviation gasoline fuel (100LL) at Hanscom.

EEA-50

EEA-51

The 2012 ESPR should provide an overview of ultrafine particulate matter (UFP) issues in ongoing air quality studies. It will report on the status of MassDOT's evaluation of UFP, as outlined in the Transportation Reform Act of 2009.

EEA-52

IX. Wetlands/Wildlife/Water Resources

The ESPR should discuss the most recent wetlands delineation, the identified vernal pools, and the perennial status of Elm Brook. ~~It should report on wildlife habitat mapping using~~

EEA-53

available information from the Massachusetts Natural Heritage and Endangered Species Program (NHESP). The ESPR should include an update of Massport's Vegetation Management Program and the Hanscom Field Grassland Management Program. It should highlight the location of the Great Meadow National Wildlife Refuge on ESPR figures.

EEA-54

EEA-55

The ESPR should report on any incremental changes to the Hanscom Field stormwater management system and to its Storm Water Pollution Prevention Plan (SWPPP). It should identify the Best Management Practices that Massport will undertake as part of the SWPPP. It should describe the water quality monitoring program at the Shawsheen River, other surface waters, and groundwater monitoring. The ESPR should provide information on the National Pollutant Discharge Elimination System (NPDES) permit. Reporting indicators for water quality improvement should include NPDES Permit monitoring results and the results from its limited monitoring program when it uses runway-deicing chemicals.

EEA-56

EEA-56

EEA-57

EEA-58

The ESPR should identify changes to the amount of impervious areas at Hanscom Field for 2005 to 2012, and that future changes to the amount of impervious area should be estimated for the 2020 and 2030 growth scenarios.

EEA-59

X. Cultural and Historical Resources

The 2012 ESPR should review the existing data on historic and archeological resources at Hanscom Field. The most current version of the State Register of Historic Places and the files of the Massachusetts Historical Commission (MHC) should be reviewed. The ESPR should describe Massport's efforts to address concerns raised by the Minute Man National Historical Park (MMNHP) and the Great Meadows National Wildlife Refuge. The National Park Service is concerned with the potential impacts of noise on the waterfowl, shorebirds, marsh birds, and turtles that use the Concord River basin. Massport should also consult with the Towns to obtain the latest historical/archaeological information. The ESPR should report on the interagency working group that was formed to review impacts on the MMNHP. It should identify and describe the National Park Service's soundscape goals and plans for the MMNHP.

EEA-60

EEA-61

EEA-62

EEA-63

EEA-64

The ESPR should identify how it will work with the four communities and the Massachusetts Department of Agricultural Resources to protect Massport-owned agricultural land from conversion to non-agricultural uses.

EEA-65

If the Federal Interagency Group is reconvened and if it publishes recommendations regarding Hanscom Field's operations, Massport should consider these recommendations and address this issue in the ESPR.

XI. Sustainable Development and Environmental Management System (EMS)

The ESPR should report on the development of Massport's Sustainable Development Program and its EMS Program. It should describe the objectives and targets, monitoring

EEA-66

procedures and roles and responsibilities to track and manage the environmental performance of Hanscom Field. This chapter should include a discussion of the following:

- Summary of existing sustainable practices currently being undertaken by Massport at Hanscom Field.
- Recycling policy and efforts.
- Toxic reduction at the airport.
- EMS Program at Hanscom Field.
- Opportunities for sustainable development practices.

EEA-67

EEA-68

EEA-69

EEA-70

EEA-71

The ESPR should include information on Massport's sustainable design program. It should include information on recycling and toxics reduction at the airport. The ESPR should also discuss the potential for incorporating other sustainable design elements into airport operations and/or the ongoing rehabilitation and expansion of existing airport facilities, including but not limited to the following:

- Optimization of natural day lighting, passive solar gain, and natural cooling;
- Use of energy efficient HVAC and lighting systems, appliances and other equipment, and use of solar preheating of makeup air;
- Favoring building supplies and materials that are non-toxic, made from recycled materials, and made with low embodied energy; and
- Provision of easily accessible and user-friendly recycling system infrastructure into building design; and development of an annual audit program for energy consumption, waste streams, and use of renewable resources.

Massport already incorporates some of these elements into its operation of the airport. The ESPR should summarize what steps Massport already takes, and how additional steps might increase environmental benefits. It should explain if Massport will conform to the MassDOT GreenDOT directives and guidelines. Additionally, Massport tenant leasing of Hanscom space should identify the sustainable measures that it requires of future tenants.

EEA-72

XII. Beneficial Measures

The 2012 ESPR should include a separate chapter on beneficial measures, which summarizes the actions described in the previous chapters (such as TDM, noise abatement, and sustainability measures). This chapter should include the identification of the parties responsible, a schedule for implementation, and the estimated costs.

EEA-73

EEA-74

The ESPR should report whether Massport will institute night-time (11:00 pm to 7:00 am) landing fees for both GA and commercial flights that charge a penalty over daytime operations. It should report on Massport's effort to develop landing fees based on noise-generated by type of aircraft, with higher fees for noisier aircraft. The ESPR should identify Massport's effort to extend the "Fly Friendly" program to commercial flights. It should report on Massport's plan to provide additional noise attenuation around engine run-up areas.

EEA-75

EEA-76

EEA-77

XIII. MEPA Documentation

The 2012 ESPR should include a copy of this Certificate, copies of all comments received, and a glossary of terms. It should include all Supporting Technical Appendices or report how reviewers can obtain a copy. The ESPR should identify when Massport will submit any interim review documents, such as Annual Reports. The documents should be made available in print and/or CD-ROM format.

A cornerstone of MEPA review is making good information on environmental impacts readily available to the public. The internet offers an excellent medium through which information can be made accessible, and updated periodically. Therefore, I ask that Massport make available on its website the executive summary information for the 2012 ESPR.

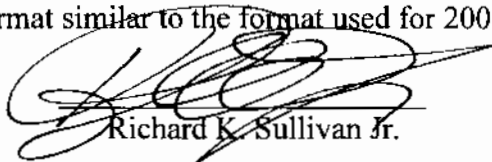
Along with reliable information, ongoing public involvement will be key to a successful ESPR process. As part of its public information efforts, Massport has proposed to:

- Convene an additional public meeting for the 2012 ESPR, which will be in addition to the MEPA consultation session for the ESPR.
- Participate in additional community meetings within the 45-day review period to discuss the ESPR as needed.

At a minimum, Massport should circulate the 2012 ESPR to those parties who commented on this Certificate, and it should send a Notice of Availability of the 2012 ESPR to Massport's mailing list for Hanscom. Copies should also be placed in the public libraries of each of the four Towns. The ESPR should respond to comments received on this Certificate. I recommend a responses to comments format similar to the format used for 2005 ESPR.

May 18, 2012

Date



Richard K. Sullivan Jr.

Comments received:

HATS Environmental Subcommittee, 4/5/12

ShhAir, 4/5/12

Belinda Gower, 4/5/12

Massport, 4/18/12

U.S. Department of the Interior/Fish and Wildlife Service, 4/19/12

Save Our Heritage, 4/19/12

National Park Service/Minute Man National Historical Park, 4/20/12

MassWildlife/Natural Heritage & Endangered Species Program, 4/20/12

Metropolitan Area Planning Council, 4/23/12

Massachusetts Port Authority, 5/4/12
Neighborhood Liaison for Concord Homes (LV Bloom), 5/8/12
Concord Museum, 5/11/12
The Walden Woods Project, 5/11/12
Congress of the United States/Nicki Tsongas & John F. Kerry, 5/11/12
Massachusetts Port Authority, 5/11/12
Representative Jay R. Kaufman, 5/14/12
Representative Jay R. Kaufman, 5/15/12
Massachusetts Port Authority, 5/15/12
Massachusetts Port Authority, 5/15/12

8696esprscope2012.doc
RKS/WTG

Congress of the United States
House of Representatives
Washington, DC 20515

May 11, 2012

Richard K. Sullivan, Jr., Secretary
Executive Office of Energy and Environmental Affairs (EEA)
MEPA Office
100 Cambridge St., Suite 900 (9th floor)
Boston MA, 02114

Attn: Bill Gage

RE: Project EEA #5484 / EEA #8696
Proposed Scope for Hanscom Field Environmental Planning and Status Report (ESPR)

Dear Secretary Sullivan,

We appreciate the opportunity to submit these comments regarding the Proposed Scope for the 2012 L. G. Hanscom Field Environmental Status & Planning Report. We hear from our constituents frequently about concerns with future expansion efforts at Hanscom Field and the potential impact on neighboring national treasures. As Massport continues to review and evaluate the current and potential future operating and environmental conditions at Hanscom Field, we appreciate your solicitation of input from the many stakeholders in the communities surrounding the Field.

As you know, Hanscom Field abuts Minute Man National Historical Park, Great Meadows National Wildlife Refuge, Walden Pond and Walden Woods, three designated Wild and Scenic Rivers, Freedom's Way National Heritage Area, 8,000 acres of protected public open space, and many other historic and natural resources that are important to our national heritage and the tourist economy of Massachusetts.

Any plans to significantly increase the private jet infrastructure at the airport, as Massport has proposed, represent a direct threat to the historically and environmentally significant areas adjacent to the airport from increased jet aviation and the resulting noise and air pollution. Due to the severity of this threat, the National Trust for Historic Preservation has designated the surrounding area as one of the "11 Most Endangered Historic Places in America."

TSO-1

Great Meadows National Wildlife Refuge is one of eight national wildlife refuges in eastern Massachusetts protecting land in seven historically significant towns. The Refuge provides important habitat for a diversity of native fish and wildlife and provides visitors with many wildlife-oriented recreational opportunities.

Nearby, the Minute Man National Historical Park is visited by more than one million people each year and preserves for future generations the important sites associated with the opening battle of the American Revolution, which led to the founding of our country. Visitors are able to experience the sights, sounds and spirit of the landscape on which the revolutionary militiamen first fought for our nation's independence. Preserving the soundscapes of the Park is critical to achieving this goal.

We understand and value the role that economic development plays in the health of our economy. Historic preservation also plays an important role in spurring sustainable growth and maintaining the appeal of these historic areas. We believe that vibrant economic growth does not need to come at the expense of the unique historical character and environment of our communities. That is why we believe it is critical that the 2012 ESPR process appropriately analyzes any proposed expansion, particularly as it pertains to the unique soundscape of this region, and how it might potentially impact such a historic landscape. ←

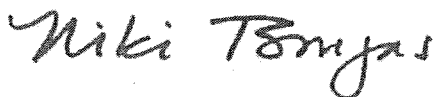
TSO-2

We share the view of Minute Man National Historical Park that 2010 should be used as a baseline to assess if the planned outcomes and environmental impacts were realized from the last ESPR. And, that ideally, the new plan would be devised to hold impacts at or below 2010 levels. Likewise, Minute Man National Historical Park, the US Fish & Wildlife Service, and community groups including the HATS Environmental Subcommittee and Save Our Heritage have also submitted comments outlining their concerns regarding the impact proposed expansion could have on the region. We believe the concerns of these valuable community stakeholders deserve your attention and consideration and that their concerns are addressed in the ESPR.

TSO-3

Thank you again for the opportunity to share these comments, and we look forward to continuing to work with you to advance our shared goals.

Sincerely,



Niki Tsongas
Member of Congress



John F. Kerry
United States Senator



National Park Service
U.S. Department of the Interior

Minute Man
National Historical Park
174 Liberty Street
Concord, MA 01742

www.nps.gov/mima

April 20, 2012

To: Richard K. Sullivan Jr., Secretary
Executive Office of Energy and Environmental Affairs
MEPA Office
100 Cambridge Street, Suite 900
Boston, MA 02114

Attn: Bill Gage

RE: Project EEA #5484 / EEA #8696
Proposed Scope for Hanscom Field Environmental Planning and Status Report
(ESPR)

Dear Mr. Sullivan,

Minute Man National Historical Park (MMNHP) is submitting these comments regarding the subject report.

Since the national park directly borders Hanscom Field and is greatly affected by operations there, we request that, as much as possible, the ESPR address specific impacts to the national park. As the starting place of the American Revolution which created our nation, MMNHP is one of the premier national parks in the U. S. Over one million visitors visit the national park each year seeking to have a contemplative experience in a historic atmosphere, in order to reflect on the origins and meaning of our nation.

We are pleased to see that there will be an analysis of the noise effects in the area and a report on the Fly Friendly program and recommended touch and go procedures over the MMNHP. However, the section on the Fly Friendly program is one of the few mentions of MMNHP in the report (besides being listed at the end as a reviewer) and we request **more focus on many more potential impacts to the park and scores of related non- federal natural, cultural and archeological resources.** Further airport expansion would likely result in an increase of air traffic noise over the park and ground traffic

NPS-1

along the historic Battle Road and other key locations. The plan's focus on growth projections will likely reveal additional adverse effects to the Park's historical and natural resources and the ability of park visitors to enjoy their experience. ←

NPS-2

The last ESPR was completed in 2005 and described planning through 2010. Therefore, we suggest that 2010 be used as a baseline so that we can assess if the planned outcomes and environmental impacts were realized. Ideally, the new plan would be devised to hold impacts at or below 2010 levels. ←

NPS-3


According to Massport's *L.G. Hanscom Field 2010 Annual Noise Report*, monitoring of noise levels in the national park show that levels are above 55 dBA, averaging 56.1 dBA. According to the National Park Service's Soundscape Indicators, ranger- conducted programs are presented in a "raised voice" with approximately 10 meters between the speakers and the furthest participants. Based on 95 percent speech intelligibility and raised voice communications at 10 meters, the EPA's speech interference threshold for this type of conversation is 52 dBA. ←

NPS-4

We commend you for including in the scope that the ESPR will report on Massport's efforts to promote service at Worcester and other airports. We urge Massport to develop a preservation solution that would place controls on development of the civilian airport within the context of a regional transportation plan. ←

NPS-5

Sincerely,



Lou Sideris

Chief of Planning and Communications



United States Department of the Interior

FISH AND WILDLIFE SERVICE

Eastern Massachusetts National Wildlife Refuge Complex
73 Weir Hill Road
Sudbury, MA 01776



April 20, 2012

Secretary Richard K. Sullivan, Jr.
Executive Office of Energy and Environmental Affairs
MEPA Office
100 Cambridge Street, Suite 900
Boston, MA 02114

EOEA #5484/8696
Attn: Bill Gage

Dear Secretary Sullivan:

Thank you for the opportunity to provide comments on the scope for the 2012 L.G. Hanscom Field Environmental Status and Planning Report (ESPR). These comments reflect issues concerning visitors and wildlife at the Concord Unit of the Great Meadows National Wildlife Refuge (NWR) that we believe need more discussion in the 2012 ESPR.

The Great Meadows NWR is administered by the U.S. Fish and Wildlife Service, which is part of the U.S. Department of the Interior, as is the National Park Service. Great Meadows NWR was established in 1944 as an inviolate sanctuary for migratory birds, for the conservation of wetlands, to provide wildlife-oriented recreation, protect natural resources, and conserve endangered and threatened species. It is one of 556 refuges in the National Wildlife Refuge System, whose mission is "to manage a national network of lands and waters for the conservation, management, and where appropriate, restoration of fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."

Great Meadows is visited by over 350,000 people each year. Most of these visits are at the impoundments located in Concord. These impoundments are one of the most important inland birding locations in the Commonwealth, and we manage them for migrating waterfowl and shorebirds. We also managed them for Blanding's turtle, a State-listed species which is also a species of regional concern due to its population status in the northeast. Additionally, the extensive wetlands along the Concord River support many migratory bird species. The Concord River itself, including the lands within the

Great Meadows NWR, is part of the National Wild and Scenic River System. It received this designation for its ecological, recreational, historical, scenic, and literary values.

In general, we request the 2012 ESRP better acknowledge the presence of the Great Meadows NWR. We request that maps that show the location of Minuteman National Historical Park next to the Hanscom Field also highlight the location of the Great Meadows NWR. The Glossary of Terms should include the Great Meadows National Wildlife Refuge. The local and regional context section of the ESRP should include a description of Great Meadows NWR and its use by visitors and wildlife. Currently most references to Great Meadows NWR are in Chapter 10 of the ESRP, which is the cultural and historical resources chapter. Interestingly enough, the historical significance of what is now the Great Meadows NWR to Henry David Thoreau and Ralph Waldo Emerson is absent from this chapter. The birthplace of the environmental movement in America is Concord, Massachusetts, and the Great Meadows themselves were heavily visited by Henry David Thoreau and others and played a significant role in the development of this environmental awareness.

FWS-1

The Concord Impoundments are located just west of runway 11-29, which is the primary runway at Hanscom Field. Our concerns are focused on noise and its impact on wildlife and visitors, and lead pollution in the sediments at the Concord Impoundments.

FWS-2

We are concerned that the potential impacts of noise on the waterfowl; shorebirds, marshbirds, and turtles that use the Concord Impoundment either year round or during important stages of their lifecycle has not been adequately addressed. Figures 7-5 and 7-7 in the 2005 draft ESRP showed numerous arrival flight tracks which come together just west of the Concord Impoundments on the way to Hanscom Field. According to the 2005 ESRP, Great Meadows NWR had by far the largest amount of conservation and historical land within the 55 Day Night Average Sound Level contour which is based on departures from Hanscom Field. Any growth models in the 2012 ESRP will likely show that this area will remain the same or will experience higher DNL contours, including up to or even above 65 DNL.

FWS-3

The impact of noise on wildlife has received increasing attention in the last few decades. Most researchers agree that noise can affect an animal's physiology and/or behavior. We recognize that there have been efforts to reduce the impact of noise on residents and Minuteman National Historical Park, but there is no recognition in the 2005 ESRP about the need to reduce noise to protect refuge wildlife. Aircraft noise does potentially impact wildlife, and it definitely impacts visitors who come to the refuge to observe and photograph wildlife or spend time in the solitude of nature. We request that Chapter 7 (Noise) address noise reduction at Great Meadows NWR or explain why this is not necessary at Great Meadows NWR. We also would be willing to discuss hosting a noise monitoring site at the Concord Impoundments so that more detailed information about noise levels could be obtained.

We also request that an independent lead test be conducted as part of the 2012 ESRP in the areas around Hanscom Field, including at the Concord Impoundments at Great

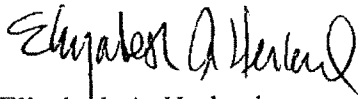
Meadows NWR. We are concerned about the level of lead emissions from aircraft using Hanscom Field as shown in the 2008 EPA Report on Lead Emissions from the Use of Leaded Aviation Gasoline in the United States. We conducted sediment sampling in 2011 in the Concord Impoundments, and upon learning of this report, we re-evaluated our results and discovered that we had dry weight lead values ranging from 10.8 to 74.5 ppm. This is higher than we expected, and while we don't have an explanation of these higher lead levels, further testing of lead in the sediments around Hanscom Field, including at Great Meadows NWR, could provide valuable information. Research has shown that in freshwater ecosystems, the lowest effect level for lead is 31 and the probable effect level – the concentration above which adverse effects are expected to occur frequently – is 91.3. See MacDonald, D.D., et al, *Arch. Environ. Contam. Toxicol.* 39, 20-31 (2000). We will be testing the blood of several Blanding's turtles this spring to determine lead levels, and will be happy to share this information with Massport.

FWS-4

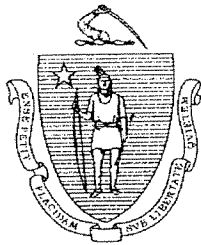
Lastly, please amend my address in the List of Reviewers to include U.S. Fish and Wildlife Service after my name.

Thank you for considering these comments. We look forward to working with Massport in the development of the 2012 ESPR. If there are questions about these comments, feel free to contact me at libby_herland@fws.gov or at 978-443-4661 ext 11.

Sincerely,



Elizabeth A. Herland
Project Leader



THE GENERAL COURT OF MASSACHUSETTS
STATE HOUSE, BOSTON 02133-1053

May 14, 2012

Mr. Thomas W. Ennis
Massachusetts Port Authority
One Harborside Drive, Suite 200S
East Boston, MA 02128-2909

Dear Mr. Ennis:

I want to thank you and Massport for the recent engagement with and responsiveness to the members of the Hanscom communities. After years of tension between Massport and the communities, I am hopeful that we have turned a page and that this more positive relationship will continue as we address the 2012 Hanscom Environmental Status and Planning Report (ESPR) and potential changes to Hanscom Field in the years ahead. It is in the context of that hope that I was most disappointed by your May 1 letter in response to the requests from the HATS Environmental Subcommittee with regard to the scope of the forthcoming ESPR.

Many of the Hanscom-area residents and officials who may wish to be involved in the ESPR process read your letter to suggest that we are clearly not on a new page. None of their concerns were addressed and none of their priority requests granted. Among the concerns are:

- **Scenarios:** During Massport's community meeting in Lexington, we were told that, unlike past ESPRs, this one would only look at a single scenario as multiple scenarios only complicated matters and muddled the waters. Our experience, in turn, of ESPRs with multiple scenarios was that Massport proceeded to argue that, having anticipated virtually any possible development in one or another of the scenarios, it was impossible for the communities to plan and Massport was in a position to claim a "blank check" for any new activity. In the course of the recent public meeting, it seemed that Massport and the communities had a shared interest in and commitment to a single-scenario ESPR this time. However, in your letter, there are references to "scenarios." I expect Massport to develop one realistic scenario grounded by Massport's clearly stated goals for Hanscom Field as part of Massport's multi-modal transportation strategy. Does Massport intend to submit one scenario as originally stated, or have you decided to pursue multiple scenarios, and, if so, why?
- **Base Line:** We continue to be deeply concerned by Massport's failure to adopt a baseline year against which to measure environmental impacts. Moving the base with every ESPR dramatically reduces the ability, indeed makes it impossible, to measure and account for cumulative impacts.
- **Lead Study:** Your May 1 letter notwithstanding, would Massport be willing to perform studies or monitoring of lead emissions from piston-engine aircraft at Hanscom in response to community concerns and the anticipated publication of new federal lead limits?
- **Air Quality:** Again, your letter notwithstanding and even though not currently required, would Massport be willing to perform studies or monitoring of fine and ultrafine particulate matter (UFP) at Hanscom, in anticipation of future federal limits and in response to community concerns?

KAU-1

KAU-2

KAU-3

KAU-4

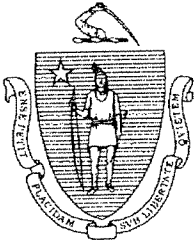
I would very much appreciate information and clarification on the communities' issues at your earliest convenience. Please contact me with any further questions, and thank you again for your cooperation and prompt assistance in this important process.

Warmly,

A handwritten signature in dark ink, appearing to read "Jay R. Kaufman". The signature is fluid and cursive, with the first name "Jay" being particularly prominent.

Jay R. Kaufman

cc: Maeve Vallety-Bartlett, MEPA
David Mackey, Massport
HATS Selectmen



THE GENERAL COURT OF MASSACHUSETTS
STATE HOUSE, BOSTON 02133-1053

May 15, 2012

Ms. Maeve Vallely-Bartlett, Director
MEPA Office
100 Cambridge Street, Suite 900
Boston, MA 02114

Dear Ms. Vallely-Bartlett:

I am writing regarding the draft scope of the 2012 Hanscom Environmental Status and Planning Report (ESPR). Hanscom-area residents, including members of the HATS Environmental Subcommittee, would like to ensure that Massport follows all environmental laws, regulations and rules pursuant to the ESPR.

On behalf of these residents, I would like to request MEPA's assistance and action on the following issues, which were noted in my recent letter to Massport officials:

- **Scenarios:** During Massport's community meeting in Lexington, we were told that, unlike past ESPRs, this one would only look at a single scenario as multiple scenarios only complicated matters and muddled the waters. Our experience, in turn, of ESPRs with multiple scenarios was that Massport proceeded to argue that, having anticipated virtually any possible development in one or another of the scenarios, it was impossible for the communities to plan and Massport was in a position to claim a "blank check" for any new activity. In the course of the recent public meeting, it seemed that Massport and the communities had a shared interest in and commitment to a single-scenario ESPR this time. However, in Massport's recent letter, there are references to "scenarios." Can MEPA limit the ESPR to a single scenario, or otherwise focus Massport's work on realistic projections? KAU-1
- **Base Line:** We continue to be deeply concerned by Massport's failure to adopt a baseline year against which to measure environmental impacts. Moving the base with every ESPR dramatically reduces the ability, indeed makes it impossible, to measure and account for cumulative impacts. Can MEPA take any action with Massport in establishing a baseline year that transcends ESPRs? KAU-2
- **Lead Study:** Can MEPA require and/or ask Massport to perform studies or monitoring of lead emissions from piston-engine aircraft at Hanscom in response to community concerns and the anticipated publication of new federal lead limits? What would trigger action from MEPA in the event new federal rules or regulations are promulgated during the course of this five-year ESPR? KAU-3
- **Air Quality:** Again, can MEPA require and/or ask Massport to perform studies or monitoring of fine and ultrafine particulate matter (UFP) at Hanscom, in anticipation of future federal limits and in response to community concerns? What would trigger action from MEPA in the event new federal rules or regulations are promulgated during the course of this five-year ESPR? KAU-4

I would very much appreciate information and clarification on the communities' issues at your earliest convenience. Please contact me with any further questions, and thank you again for your cooperation and prompt assistance in this important process.

Warmly,

A handwritten signature in dark ink, appearing to read "Jay R. Kaufman". The signature is fluid and cursive, with the first name "Jay" being more prominent.

Jay R. Kaufman

cc: David Mackey, Massport
Thomas Ennis, Massport
HATS Selectmen

Ennis, Tom

From: Gage, Bill (ENV) [bill.gage@state.ma.us]
Sent: Friday, April 20, 2012 3:51 PM
To: Ennis, Tom
Subject: FW: Proposed scope for Hanscom Field Environmental Status and Planning Report (ESPR); EoEA # 8696 (NHESP # 01-9192)

From: Schluter, Eve (FWE)
Sent: Friday, April 20, 2012 1:05 PM
To: Gage, Bill (EEA)
Cc: Coman, Amy (FWE)
Subject: Proposed scope for Hanscom Field Environmental Status and Planning Report (ESPR); EoEA # 8696 (NHESP # 01-9192)

Dear Bill,

The Natural Heritage & Endangered Species Program (NHESP) of the Massachusetts Division of Fisheries & Wildlife has reviewed the proposed scope for the Hanscom Field ESPR. The site is mapped Priority Habitat for state-listed grassland bird species. The NHESP looks forward to reviewing the ESPR pursuant to the MESA, including any newly proposed development initiatives and on-going vegetation management plans. Please let me know if you require any additional comments. ←

ESP-1

Thanks,

Eve

*Everose Schlüter, PhD
Endangered Species Review Biologist
Natural Heritage & Endangered Species Program
Massachusetts Division of Fisheries and Wildlife
1 Rabbit Hill Road
Westborough, MA 01581
Voice: (508) 389-6346
Fax: (508) 389-7891*



April 20, 2012

Richard K. Sullivan, Jr., Secretary
Executive Office of Energy & Environmental Affairs
Attention: MEPA Office
William Gage, MEPA#8696
100 Cambridge Street, Suite 900
Boston, MA 02114

RE: Proposed Scope – 2012 L.G. Hanscom Field Environmental Status and Planning Report (ESPR), MEPA #8696

Dear Secretary Sullivan:

The Metropolitan Area Planning Council (MAPC) regularly reviews proposals deemed to have regional impacts. The Council reviews projects for consistency with *MetroFuture*, the regional policy plan for the Boston metropolitan area, MAPC's Smart Growth Principles, and the Commonwealth's Sustainable Development Principles, as well as for their impacts upon the environment.

Massport prepares an Environmental Status and Planning Report (ESPR) every five years to evaluate the cumulative impacts of growth and change at Hanscom Field and provide data and analyses on noise, transportation, air quality, and water quality. The 2012 ESPR will present an overview of the operational environment and planning status of Hanscom Field and will provide long-range projections of environmental conditions. The ESPR will contain historical environmental information, current information, and a forecast of future environmental effects at Hanscom Field.

At the March 20, 2012 ESPR scoping meeting, the issue of levels of lead emissions from aviation gasoline was raised and a U.S. EPA report, 'Lead Emissions from the Use of Leaded Aviation Gasoline in the United States' (2008) was referenced. According to this report, Hanscom Field releases an estimated 533 kilograms or 0.6 tons of lead by piston-engine aircraft during the landing and take-off cycle. Hanscom Field ranks 33rd of 3,414 airport facilities nationwide identified in this report. The potential of environmental impacts resulting from the current level of emissions, and the possibility of additional emissions if growth is projected for the airport, were raised at this meeting. MAPC respectfully requests that Massport address this concern in the ESPR.

MPC-1

MAPC looks forward to reviewing the draft ESPR.

Sincerely,

Marc D. Draisen
Executive Director

cc: Walter J. St. Onge III, Town of Bedford
K.C. Winslow, Town of Concord
Richard Canale, City of Lexington
Christopher Reilly, Town of Lincoln
Keith Bergman, MAGIC
Tom Ennis, Massport

60 Temple Place, Boston, MA 02111 • 617-451-2770 • Fax 617-482-7185 • www.mapc.org

Advisory Board

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Douglas Brinkley, Author, Professor of History,
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University of Connecticut
John Burns, Director, Producer,
Historical Documentarian
Howard Countryman, Professor of History,
Southern Methodist University
Robbie Cox, Former President, National Sierra
Club
Sean Cusack, Actress
Michael S. Dukakis, Professor, UCLA &
Northeastern University, Former Governor of
Massachusetts
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Ron Henley, Recording Artist, Founder, Walden
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Washington University
Laura Johnson, President,
Massachusetts Audubon Society
Representative Jay Kaufman (honorary)
Michael Kellett, Executive Director, Thoreau
Country Conservation Alliance & RESTORE:
The North Woods
Barry Meehan, Chancellor, U. Mass. Lowell
Congressman Edward J. Markey (honorary)
David McCullough, Historian, Author
John Hanson Mitchell, Author,
Editor of Sanctuary Magazine
Richard Moe, Former President,
National Trust for Historic Preservation
Wesley T. Mott, Editor, Emerson Society Papers,
Professor Worcester Polytechnic Institute
Representative Charles Murphy (honorary)
Congressman John F. Tierney (honorary)
Congresswoman Nicola S. Tsongas (honorary)
Edward O. Wilson, Naturalist,
Professor Emeritus, Harvard University
Joanne Woodward, Actress, Humanitarian
Alfred F. Young, Professor Emeritus of History,
Northern Illinois University

Stewards of Sites

Nancy Nelson, Superintendent,
Minute Man National Historical Park
Libby Herland, Project Leader,
Great Meadows National Wildlife Refuge, U.S.
Fish and Wildlife Service
Jan Turnquist, Executive Director, Orchard House

Executive Director

Anna West Winter



Save Our Heritage

Protecting the birthplace of the American Revolution,
the cradle of the American Environmental Movement,
and the home of the American Literary Renaissance.

April 19, 2012

Richard K. Sullivan, Jr., Secretary
Executive Office of Energy and Environmental Affairs (EEA)
MEPA Office
100 Cambridge St., Suite 900 (9th floor)
Boston MA, 02114
Attn: Bill Gage

RE: Project EEA #5484 / EEA #8696
Proposed Scope for Hanscom Field Environmental Planning and Status
Report (ESPR)

Dear Mr. Sullivan,

In 1974 Massport acquired ownership and operational control of L.G. Hanscom Field. Since that time, the abutting historic landscapes and natural resources -- along with the host historic communities -- have been designated a Last Chance Landscape by *Scenic America* and one of the 11 Most Endangered Historic Places in America by *The National Trust for Historic Preservation*. These designations are a result of Massport's aviation impacts; they still stand, and they have yet to be resolved. We are hopeful that the 2012 ESPR process will usher in a unique yet critical opportunity to plan for a sensitively mitigated and environmentally responsible and sustainable future for Hanscom Airport.

SOH-1

Given the clear and highly unfortunate power disparity between Massport, a state authority committed to development (subject to no local zoning, noise ordinances, or taxes) and the four historic suburban towns committed to preservation (governed by town meeting vote) it is no wonder that decades of conflict, legal battles, and resentment have ensued.

Existing within a two-mile radius of the Airport are thousands of nationally and internationally recognized landmarks of significant historic and environmental importance. These sites draw millions of visitors annually and are a major contributor to the state's economy and, most importantly, to its nationally recognized identity.

Sites directly abutting -- or within a 2 mile radius of the airport include:

- Minute Man National Historical Park (recently expanded - H.R. 146, an *America's Great Outdoors* public/private initiative, and honored by Congressional Resolution in 2009);
- Great Meadows National Wildlife Refuge
- Thoreau's Walden Pond and Walden Woods
- Three Designated Wild and Scenic Rivers
- The Estabrook Woods
- Freedom's Way National Heritage Area
- The homes of Emerson, Thoreau, Hawthorne, and Alcott
- Over 1,000 National Register eligible sites
- 8,000 acres of protected public open space
(the largest tract of open space in the suburban Boston area).

There are over 14,000 airports in the United States. There is only one Birthplace of the American Revolution, only one Home of the American Literary Renaissance, and only one Cradle of the American Environmental Movement. The 2012 ESPR should reflect a genuine commitment to preserve the sanctity of these national treasures. ←

SOH-2

The following comments align with the named sections of the February 2012 Proposed Scope document

Comments on Introduction

The communities remain hopeful that Massport will prove to act in accordance with the statement that prefaces their proposed scope: "the authority is committed to a multi-modal, multi-airport, multi-state regional transportation system that will satisfy future regional aviation demand."

We ask that Massport be directed to respect the need for the establishment of a fair and balanced regional NE transportation system and encourage multi-modal services such as the Acela service to NY and DC. As a result, the ESPR should not study scenarios involving any additional ticketed commercial service out of Hanscom. In 2000-2003, when Massport was actively courting airlines, and subsidizing a lease to Shuttle America, the noise impacts of 220,000 operations over the residential communities proved intolerable (as evidenced by multiple citizen protests) and public enjoyment of the natural and historic resources was severely diminished. After decades of costly and failed attempts to establish viable commercial service at Hanscom, we look to Massport to honor the 1978 Master Plan that stipulates a 30 seat limit for commuter aircraft and excludes certificated passenger service. ←

SOH-3

Hanscom Field's Master Plan and Noise Rules

Nowhere is it written that the 1980 noise rules supersede the 1978 Master Plan. Massport states they will study scenarios compatible with both. But the Master Plan limits commuters to 30 seats and the noise rules limit commuters to 60 seats. Inexplicably, Massport takes the position that the limit number is 60, but the Master Plan stipulates 30. The noise rules don't supersede the Master Plan; they are just other parallel rules. So, **for Massport to comply with both -- and honor the sensitive environment they already seriously impact -- they must comply with the lower number.** ←

SOH-4

History and Purpose of Environmental Status and Planning Report

As a result of previous GEIR/ESPR scenario growth studies, the communities have witnessed ESPR scope hypotheticals become quickly sought-after Massport objectives: i.e. ticketed commercial airline service, the introduction of heavy commercial cargo, and the doubling of hangar infrastructure. Despite Massport's attempts to encourage unprecedented expansion, the communities were heartened when the majority of Massport-solicited airlines and the FEDEX Corporation proved to value the sanctity of the historic resources over potential for corporate gain and ceased to pursue operating out of Hanscom.

At the present -- yet still evolving state of environmental regulations -- there are very few legal statutes that exist to protect unique and invaluable natural and historic resources from aviation impacts. Only a unified commitment to common sense and sensibility on the part of all stakeholders can chart a shared course toward a responsible and sustainable balance between this airport and its host communities. **We look forward to MEPA's encouragement of a single scenario scope that holds impacts at 2010 levels; implements an innovative plan to further mitigate all fleet-mix impacts; and complies with the Minute Man Park Soundscape Plan and the recommendations of the Federal Interagency Working Group charged with the mission to develop long-term protection goals for the Park and environs.** ←

SOH-5

Public Review and Participation

As stewards of the cradle of the American Environmental Movement, the citizens of these communities take very seriously environmental stewardship and protection. They have been both hopeful and diligent as they have invested countless volunteer hours and financial resources in past ESPR processes. Unfortunately, after their research was ignored and their input and concerns summarily dismissed, the host towns viewed future participation as a futile proposition. In 2005, the communities and the National Park Service boycotted the process.

Massport has asked the communities, the sites stewards, the National Park Service and U.S. Fish and Wildlife, to return to the table and work with them on the 2012 ESPR. The communities

would like nothing more than to find a commonality of purpose and direction, and will -- once again -- remain hopeful that Massport will seize the opportunity to engage in a sensitive and appropriate scoping process and an honest environmental assessment -- limiting the growth scenarios studied and inclusive of new and innovative mitigation measures to be applied to current and future impacts.

Comments on proposed ESPR sections

III. Airport Activity Levels

SOH-6

The 2012 ESPR should exclude study of additional commercial and cargo operations; Massport, now owning and operating three Massachusetts Airports, can facilitate these limitations via a **multi-airport sponsorship**. In addition, Massport should simultaneously prepare an **ESPR for Worcester Airport**. The relationship between Hanscom and Worcester is of great significance. As Massport works to encourage commercial carriers to service central and western MA via Worcester, the growth of FBOs for large GA traffic may also present economic opportunity for the Worcester facility while serving to reduce the imbalance and monopoly of jet activity at Hanscom.

IV. Airport Planning

SOH-7

In order to hold impacts to 2010 levels, parameters, limitations, and mitigation methods need to be defined for the proposed current build-out of facilities (*please see attached chart*). Massport's plans to double Hanscom hangar infrastructure to house some of the largest luxury private jets manufactured (Gulfstream 650s) has recently been given the green light to proceed by virtue of a Finding of No Significant Impact (FONSI). Once again, we are reminded that in order for the FAA and Massport to find a "significant" noise impact relative to any of their aviation practices, levels within the park and communities would need to reach a threshold deemed -- in FAA terms -- **"incompatible with residential land use"** (65 db DNL). Until the day dawns when the cradle of the American Environmental Movement is officially regarded as **humanly uninhabitable**, this internationally beloved landscape is succumbing, via "insignificant" incremental assault, to a fate of *death by a thousand cuts*. Unlike a condominium complex -- Walden Country, Minute Man Park, The Estabrook Woods, and Great Meadows National Wildlife Refuge can't be soundproofed with acoustic insulation panels.

Proposed aviation activity should be compatible with the Soundscape Plan of Minute Man National Historical Park. In the EA for Hangar 24 (including East Ramp build-out) Massport states that all new aircraft encouraged by the infrastructure expansion will most likely be large jet aircraft and that they **will not** impact Minute Man Park because they will be using the long runway. However, the North Bridge and Barrett's Farm Units of the National Park **are** impacted by the long runway. In addition, the "long runway" -- the Concord-Lexington runway (11/29) --

facilitates approx. 80% of operations and significantly impacts the historic downtown areas of Concord and Lexington as well as protected public open space areas which include Great Meadows National Wildlife Refuge and The Estabrook Woods. Study of operations on this runway should begin with mitigation of current disproportionate impacts. **Higher elevations employed in take-off and landing procedures should be investigated and implemented. Unlike Logan -- with an ocean to fly over as a means to reduce local impacts -- utilization of Rt. 2 and Rt. 128 corridors for flight patterns should be examined.**

Landside Planning

SOH-8

A permanent boundary footprint should be established for Hanscom Field. This is a key component in the establishment of an environmentally sustainable airport that abuts sensitive historic national landmarks. The threshold of reasonable soundscape preservation of these historic and natural resources of centuries past will never be increased, therefore, the environmental impact of this facility cannot continue to increase or these resources will be lost to future generations.

Traffic impacts of non-active aviation development

SOH-9

The communities supported a museum commemorating local aviation accomplishments to be housed in the historic Hangar 24 (18,000 sq. ft.). The size and content of such a museum was considered an appropriate addition to the community and of comparable scale with other local museums and historic sites. However, the proposed non-locally focused "Air and Space Museum" is slated to be a large structure (150,000 sq. ft.) built on 17 acres of tax exempt land and leased from Massport for a dollar a year. This tax-free facility will offer air-side facilities for individuals to house their private collections of aircraft and **needs to be evaluated for the potential to generate significant additional traffic on Battle Road (already considered failed at the intersections).** In addition, any air-show aviation traffic it generates during the spring, summer, and fall seasons -- when children, families, and tourists venture out to enjoy the National Park, historic sites and open space -- would be viewed as detrimental and unwanted by the communities and site stewards. **Additional activity of these antique and "show" planes should be studied and added to the proposed fleet mix.**

V. Regional Transportation Context

SOH-10

As evidenced by the MAC study of Massachusetts GA Airports, any further Hanscom expansion plan threatens the "multi-airport" transportation program because it places a state agency in direct competition for aviation traffic with local smaller underutilized airports (and the related small businesses) that are seeking economic opportunities. In addition, the continued amassing of infrastructure, in order to monopolize operations, disproportionally concentrates environmental impacts on the Hanscom communities (The number of Hanscom operations is 2nd only to Logan International Airport within the New England Regional Aviation System).

VI. Ground Transportation

SOH-11

The scenario studied should not increase ground traffic on the Historic Battle Road. We ask that Massport be directed to comply with the mission and plans of the National Park Service and honor the integrity of Freedom's Way National Heritage Area. Expanded intersections and additional traffic lights are antithetical to the congressional vision of the centerpiece of Minute Man National Historical Park.

VII. Noise

SOH-12

The primary noise impact metric for this ESRP should be the Time Above (TA) metric, which is the best metric for establishing duration of noise-impacted time, and has consistently been the measure of interest of the public and to the historic sites. The more common DNL metric should be reported for trending, but has been repeatedly shown to be primarily a measure of a small number of loud events and, because it is insensitive to the impacts of frequent smaller aircraft, it is unsuitable for describing the impacts of the diversity of aircraft at Hanscom Field. The TA standard metric was first reported by Massport in the 2000 ESRP. For comparison, trending, and scenario analysis, the following TA contours should be generated, in addition to the tabular TA data for sensitive receptor sites:

Contours for TA55dba: 15, 30, 60 and 90 minutes

Contours for TA65dba: 15, 30, 60, and 90 minutes

The Impact of Aviation Noise on Human Health:

Given the low ambient baseline sound levels that exist in the neighborhoods and within the protected public open space under the Hanscom flight paths, the negative impacts of aviation noise are often more substantial than in a city where ambient levels are higher and jet noise is less perceptible. **Multiple studies have confirmed that airplane noise is not simply a "disturbance" -- it is injurious to human health** (*Study: Airport Noise Increases Risk of Strokes – Tristen Moore/Berlin 2009*). It is now linked to cardiovascular disease, hypertension, depression, and stroke. In a study conducted by Germany's Federal Environmental Agency, men exposed to jet noise had a 69% higher risk of being hospitalized for cardiovascular disease and woman had a 93% higher risk than those not exposed. In addition, the study found women who are exposed to about 60 decibels of jet noise during the day are 172% more likely to suffer a stroke. Eberhard Greiser, professor of epidemiology at Bremen University, explains why aviation noise is hazardous to human health, "**Jet noise is more dangerous than any other kind of road-traffic noise because it is especially acute and sharp and induces stress hormones.**" His study concluded that females subjected to aviation noise had a significantly higher incidence of depressive disorders in addition to hypertension.

Once again, it becomes clear that an FAA metric defining the impacts of aviation noise as a one-

metric-fits-all-and-every-landscape is profoundly flawed and needs proper assessment by our environmental protection agency. **MEPA should recommend that Massport conduct a health assessment study of those residents living under the flight paths in the four towns.**

VIII. Air Quality

SOH-13

The 2012 ESPR air quality assessment must include Lead. The EPA issued a 2008 report "Lead Emissions from the use of Leaded Aviation Gasoline in the United States" **listing Hanscom in the top 1% of lead emitters of over 3000 airports.** The atmospheric lead limits have recently been reduced by the EPA. In the U.S., piston planes still burn leaded fuel. A CA airport, with emissions near Hanscom levels, was tested and found by the EPA to be outside of the Federal lead limits. Given that Hanscom generates over 100,000 piston plane operations per year, there is a legitimate concern that Hanscom may exceed federal lead limits. Proper abatement could involve switching planes over to unleaded fuel, reducing the number of piston plane operations, and/or ceasing to allow the piston planes to circle the towns. In addition, emission particulates and CO2 equivalent should be measured and reported.

IX. Wetlands/Wildlife/Water Resources

SOH-14

Lead measurements should be conducted by an independent source. Samples should be taken from still bodies of water in areas under the flight paths and in close proximity to the airport. Special attention should be given to investigating possible pollution and contamination of water resources within Great Meadows National Wildlife Refuge where the turtle populations have been steadily declining. Lead tests should be done during the spring and fall seasons when recreational flying is at peak levels.

X. Cultural and Historic Resources

SOH-15

L.G. Hanscom Field is the only airport in the country that abuts a living history National Historical Park of the 18th century, a National Wildlife Refuge and the internationally recognized Birthplace of the American Conservation Movement. For these reasons, a one-size-fits-all approach to measuring and evaluating environmental impacts is both insufficient and inappropriate within a landscape that has been painstakingly protected and still offers preserved open space with low ambient natural sound (L₉₀ of 35 - 40 dbA).

In 2001 (after Massport -- in contravention of the 1978 Master Plan -- changed the certification of the airport to allow for operations of 60 seat ticketed commercial aircraft) **President Clinton and FAA Administrator Jane Garvey established a Federal Interagency MOU between the National Park Service, the FAA, DOI, DOT, Federal Highway, and The Advisory Council on Historic Preservation to work towards long-term preservation goals for the historic area.** In

2002 – the document, *Hanscom at the Crossroads* was submitted to Massport and the Governor - calling for an immediate moratorium on additional aviation, infrastructure improvements and new development until a regional multi-modal transportation plan is established and enacted -- recognizing the need to preserve the historic environs of the National Park, the natural resources, and the four host towns. Signatories included: Congressmen Ed Markey, John Tierney, and Marty Meehan, Massachusetts State Senators and Representatives, and nine surrounding towns.

XI. Sustainability

SOH-16

In public meetings Massport commonly uses the term “sustainability” to mean financial sustainability rather than the more common use of environmental sustainability. Charging appropriate fees for landing, parking, and leases will provide L.G. Hanscom Field Civilian Airport with the financial resources to reach and retain financial sustainability without the need to expand beyond the current footprint or increase impacts beyond 2010 levels. Massport should not be allowed to use its financial “sustainability” goals as a justification for facility or operations growth.

In closing, we remain optimistic that the host towns of Concord, Lexington, Lincoln, and Bedford, the National Park Service, U.S. Fish and Wildlife and the site stewards will be successful in partnering with Massport in developing a responsible and economically sustainable plan for the future of L.G. Hanscom Field Airport. The only plan that will achieve the much-needed balance between this facility and its irreplaceable historic and natural resources will be a creative and innovative plan designed outside the box of monopolies, power, and profit. It must begin by the commencement of an honest study of legitimate environmental sustainability. The HATS Environmental Subcommittee has requested that the year 2010 be considered the baseline of impacts not to be exceeded. If we can all agree on this very reasonable starting point, then let's roll up our sleeves and get to work.

Sincerely,



Anna West Winter
Executive Director, Save Our Heritage Inc.

Massport Expansion of Infrastructure at Hanscom Field

(4.2.12)

Project	Square Feet	Timeline	Comments	Purpose
New FBO* at Hangar 24 site	96,000	Next 2 years	<ul style="list-style-type: none"> 60,000 sq ft new hangar, plus 36,000 sq ft of office space Hangar 24: 18,500 sq ft Rectrix to invest \$15 million here & \$5 million at Worcester This will be the 3rd FBO at Hanscom Field. 	To attract, service and house new & larger aircraft (Gulfstream 650s), as well as other aircraft
New Jet Aviation hangar	44,000	This year	This will replace an existing 22,000 sq.ft hangar to accommodate & attract larger Gulfstream transatlantic jets. Jet Aviation is 1 of 2 existing FBOs at Hanscom.	To attract, service and house new & larger aircraft (Gulfstream 650s)
Navy surplus property	32,000	Near future	Massport submitted a bid for this airside property on 1/17/12. This, together with the FBO at the Hangar 24 site, would create <u>two</u> NEW active airside spaces at Hanscom	n/a
East Ramp, 6 – 10 new hangars	400,000	Pending	This is equivalent to 8 football fields.	To attract and house new aircraft, and house existing ones.
Mass. Air & Space Museum (MASM)	150,000	2015	<p>The museum would be an additional source of increased air and ground traffic. The MASM brochure states,</p> <p><i>"The museum must be at an airport with aircraft ramp access, in an easily accessible location at or near the population center of the state with good visitor traffic and accessibility. There must be adequate acreage to support an initial museum structure and provide expansion space for future growth."</i></p>	<p><i>"The mission of the Mass. Air & Space Museum is to preserve, display, educate, and motivate future MA generations to continue this important tradition [aeronautical research and development]."</i></p> <p style="text-align: right;">—MASM brochure</p>
TOTAL	722,000 sq ft		<p>TOTAL NEW INFRASTRUCTURE</p> <p>Total existing infrastructure: 230,000 sq ft</p>	Cumulative impact on traffic? On noise? On pollution? On Minute Man Park, Great Meadows, and the 1000s of other historic & natural resources in our towns?

*Fixed Base Operator, service facility for private luxury jets and other aircraft

HATS Environmental Subcommittee

c/o Town Office Building, Massachusetts Avenue, Lexington, MA 02420

April 4, 2012

Secretary Richard K. Sullivan Jr.
Executive Office of Energy and Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Ms. Maeve Vally-Bartlett
Executive Office of Energy and Environmental Affairs (EEA)
100 Cambridge St., Suite 900 (9th Floor)
Attn: MEPA Office
Boston MA, 02114

Dear Secretary Sullivan and Ms. Vally-Bartlett,

As the Chairman of the Hanscom Area Towns Committee's Environmental Subcommittee (HATS ES), I am submitting these remarks on Massport's February 2012 Proposed Scope for the 2012 Environmental Planning and Status Report. The Hanscom Area Towns Committee (HATS) is the Growth and Development Policy Committee established under M.G.L. 40 § 4I with Bedford, Concord, Lexington, and Lincoln as member municipalities.

Massport indicates that its proposed scope responds to the Secretary's March 29, 2007 Certificate on the 2005 ESPR. However, significant events have occurred that should require Massport to modify its scope. ←

HAT-1

Massport has now acquired Worcester Airport making Hanscom Field now part of a three-airport system. Massport has begun a 2011 update process to its Logan ESPR, but it has not yet planned for an ESPR for Worcester Airport. Because of inter-related activities between Worcester and Bedford airports (e.g. the recent January announcement by Massport – "Massport Approves General Aviation Development at Worcester Regional Airport and L.G. Hanscom Field") it seems that there needs to be better planning as to how the activities at Worcester and Hanscom inter-relate. I believe the Secretary should require Massport to ensure that this scope will accomplish that by doing a concurrent ESPR or by other means. Because of the potential magnitude of this event, the scope should not be approved until there is better clarity on how the ESPR can address this issue. ←

HAT-2

The four communities did not participate in the review of the 2005 ESPR because the HATS communities regarded the ESPR process as an ineffective means of avoiding environmental

damage to the sensitive area surrounding Hanscom Civilian Airport. Among the concerns are that there is no articulated basis for the ESRP process within the MEPA Regulations, and that there are no longer any meaningful review thresholds that are applicable to addressing the environmental impacts caused by expansion at Hanscom Civilian Airport. The communities are hopeful that this ESRP process can be a productive process. We do seek your advice on how we can work with your Office to develop meaningful provisions that will effectively limit harmful environmental degradation as a result of Massport's articulated civilian airport expansion.

In any event, the following are my initial comments on what Massport has submitted. I have sent a number of questions to Massport on Monday, and obviously, they are still formulating responses. I have attached the list of questions. The HATS ES will have additional comments when Massport responds to these questions. We expect to meet with Massport sometime next week.

Master Plan and Noise Rules On page 2 of 5 "In 1978, the Authority prepared a Master Plan for the airport. The preparation of the Master Plan included a lengthy and comprehensive public process. In 1980, after additional public process, Massport adopted the Hanscom Field Noise Rules, which were an outgrowth of the Master Plan. The Master Plan and the 1980 Noise Rules remain the framework for airport planning and operations today"

Note, there is nowhere that it says the noise rules supersede the Master Plan, Massport states they will study scenarios compatible with both. But, the Master Plan limits commuters to 30 seats and the noise rules limit to 60 seats. Massport is taking the position that the limit number is 60, but the Master Plan says 30. Note the master plan also prohibits certificated passenger service, which is of course what Shuttle America operated. The noise rules do not supersede the master plan; they are just other parallel rules. Compliance requires the lower number be used. You should rule that the chosen scenario not include flights with more than 30 seats.

History and Purpose of ESRP In addition to the comments above, I urge you to require Massport to document how this Report series has historically been an effective planning tool. It will be helpful if Massport is required to show how they will actively plan for a constrained future buildout, rather than expanding whenever any entity asks for expansion of facilities or operations. Market demand for air travel could allow for unlimited growth and should not be permitted to be the ultimate determining factor in the ESRP analysis.

Public Review and Participation Community volunteers who have participated in the past have become discouraged by the perfunctory character of the previous ESRPs and their failure to protect in a meaningful way our surrounding historical sites and the US Minute Man Historical National Park (MMNHP) from environmental damage to the Environment. I hope that your office will ensure that this 2012 process will be meaningful.

Format of the 2012 ESPR We believe the format and process of the 2000 and 2005 ESPR was flawed. I have attached the HATS ES prior analysis of those flaws.

The 2005 ESPR was based upon 2005 data and forecast 2010 potential scenarios. The base year for this ESPR should be based upon 2010 actual conditions so that we can have a clear evaluation of 2010 forecasts vs. actual operations and environmental conditions. There is no rational basis to use 2012 as the base year as proposed. 2010 could be the baseline for all future planning and project analysis of environmental impacts so that the cumulative effects of incremental impacts don't get lost, provided that there is a retrospective look back to the real base line of 1985, the year of the first GEIR. Planning constraints for operations need to be put in place to ensure that environmental impacts are based on 2010 impact levels or lower.

HAT-3

HAT-4

You should require Massport to develop a metric that equates types of operation with types of environmental impacts. Massport uses numbers of operations as if it represented a fixed impact irrespective of whether it is a single engine plane operation or a commercial cargo plane operation.

The single scenario that is chosen for analysis should be required to be realistic and based upon factors such as how well the 2005 scenarios for 2010 were actualized, as well as taking into account additional factors such as: planned activities of Hanscom in the context of now being in a three airport system and the recommendations that come out of the Inter-agency Workgroup on protection of the Minute Man National Historical Park and Environs. A quantified limit to the scenario chosen should be defined up front and included in the Scope document and should be required to only include any scenario that falls within the parameters of the Master Plan.

HAT-5

Based on Massport's recent assertions, the fleet mix in the scenario should not include any commercial cargo operations and no expansion of the incidental cargo as currently operationalized today. The fleet mix should not include commercial passenger service in planes having more than 30 seats. Leaded fuel based operations should be limited as described in the Air Quality section.

Airport Planning & Regional Transportation Context My comments at the top of this letter are crucial to setting a New England regional transportation context. A multi-modal regional transportation policy coherence should be required to set the basis for future development planning at Hanscom.

Ground Transportation No specific comments at this time.

Noise Time Above (TA) metrics should be integrated into the ESPR at a level as recommended by the Hanscom Workgroup and as stated previously by your predecessor. The TA contours are much more important than the DNL contours for assessment of noise impacts. The analysis needs to include a sufficient number of TA noise contours at agreed upon spaced noise level

amounts above ambient in order to demonstrate more clearly the amounts of annoyance and disturbance to residents than the usual assortment of DNL type measurements

HAT-9

Air Quality & Wetlands/Wildlife/Water Resources ESPR should be required to conform to all the MassDOT GreenDOT directives. GreenDOT sets a goal of reducing greenhouse gas emissions over 2 million tons by 2020, a reduction of about 7.3 percent below 1990 transportation sector emission levels. Massport should set goals and projections in this ESPR, and report on what base level it will use going forward along with quantitative measures of current direct and indirect sources of GHGs at Hanscom. The ESPR should take into account particulate matter including fine and ultra-fine matter in conformance with the Transportation Reform Act of 2009 and report on how it will fund/study health effects in a parallel way as the Logan Health Study.

HAT-6

HAT-7

ESPR needs to report on its commitment to monitoring/measuring lead emissions from aircraft and measure lead levels in nearby ground, water, and air, and include any lead based emissions from other sources that could add to the already high level of airplane lead emissions at Hanscom. The ESPR air quality assessment must include lead measurements and modeling of

HAT-8

lead migration into nearby ground, water, and air resources. The EPA issued a 2008 report "Lead Emissions from the use of Leaded Aviation Gasoline in the United States" saying Hanscom is in the top 1% of lead emitters of over 3000 airports. In addition, the EPA has recently reduced the atmospheric lead limits. Piston planes still burn leaded fuel. Another airport with emissions estimated to be near Hanscom levels (located in California) was tested and found by the EPA to be outside of the Federal lead limits. There is a legitimate concern that Hanscom may exceed federal lead limits. According to the EPA report, Hanscom's lead emissions are 533 kg/year, or 1175 lbs./year, because of the large percentage of piston engine aircraft at Hanscom (71%) which still use leaded aviation fuel. Jets and commercial aircraft no longer use leaded fuel. Much of Europe has phased out leaded aviation fuel altogether, but lobbyists in the US have successfully fought its continued use. The ESPR needs to address how measured levels may affect fleet mix and operations of leaded fuel based planes. As part of the ESPR process, Massport should fund an independent study on the air, ground and standing water around Hanscom Field.

Cultural and Historical Resources No additional comments at this time.

Sustainable Development and Environmental Management System No additional comments at this time.

MEPA Documentation The communities hope that your office will include additional instructions that allow the 2012 ESPR to be a worthwhile process and for it to become a meaningful planning document.

HATS Environmental Subcommittee comments to MEPA on Massport Proposed ESPR Scope April 4, 2012

Please let me or the HATS Chair, Ms. Deborah Mauger, know if you have questions or wish further discussion.

Sincerely,

Richard Canale (signed)

Richard Canale,
HATS ES Chair

Copies:

William Gage, MEPA Analyst

HATS Selectmen.

HATS ES members

Jeanne Krieger, HFAC Chair

Nancy Nelson, Superintendent, Minute Man National Historical Park

Tom Ennis, Massport

Dorothy Steele, Massport

HATS Environmental Subcommittee

c/o Town Office Building, Massachusetts Avenue, Lexington, MA 02420

February 15, 2005

To: The HATS Committee

RE: L. G. Hanscom Field Airport Environmental Status and Planning Report (ESPR)

In the past, the HATS Environmental Subcommittee (ES) has spent long hours in analyzing Massport documents, participating in meetings with Massport and other folks, and helping frame Community concerns through the ESPR/GEIR process.

At this time Massport wishes to begin to plan for a new 2000 ESPR and requests to meet with the HATS ES. We are aware that, for some time, the HATS Committee has questioned the efficiency and effectiveness of the ESPR process as it has unfolded.

Accordingly, we have canvassed the members of the ES Committee and conclude that HATS ES members are reluctant to participate in a 2005 ESPR process on behalf of the communities for the following reasons:

- During the 2000 ESPR process, we found that Massport was not sufficiently responsive to community questions or comments. We believe that we and our consultants carefully reviewed Massport documents and asked pertinent questions in writing and verbally on presented issues, but did not receive complete answers. Nonetheless, our comments were based on solid analysis, and were well documented. Many of our comments still have not yet been addressed.
- MASSPORT unilaterally presented Hanscom growth scenarios without collaborating on how they aligned/misaligned with local and regional plans.
- Massport did not fully implement a number of the recommendations in the Certificate issued by the Secretary of the Executive Office of Environmental Affairs (EOEA) after the 2000 ESPR. HATS wrote to Massport about several MEPA Certificate recommendations that didn't seem to be addressed yet by Massport. Massport responded by letter to HATS but did not fully address the HATS concerns.
- The current MEPA regulations (301 CMR 11.00), as revised in 1998, were streamlined and the few review thresholds that might be triggered by Hanscom development were largely eliminated. The Secretary of the EOEA and the MEPA Office have little oversight of environmental degradation that occurs as a result of

Hanscom development. In any event, the workload of MEPA staff is not sufficient to allow more than a cursory review of an ESPR document.

- Community volunteers who have participated in the past have become discouraged by the perfunctory character of the previous ESPRs and their failure to protect in a meaningful way our surrounding historical sites and the US Minute Man Historical National Park (MMNHP) from environmental damage to the Environment.

The HATS ES requests that HATS seek more effective and efficient review processes. The HATS ES stands ready to work with you on this.

TOWN OF LINCOLN

REC'D JUN 09 2005



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781/259-2600
FAX 781/259-1677

BOARD OF SELECTMEN
Sarah Cannon Holden, Chair
Sara A. Mattes
Gary A. Taylor

COPY

April 19, 2005

Secretary Ellen Roy Hertzfelder
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, MA 02114

RE: ESPR, EOE A #5484/8696, for L.G. Hanscom Field

Dear Secretary Hertzfelder:

The Hanscom Area Towns (HATS) are keenly interested in preserving the historic environment and resources of our communities and acting as responsible stewards of these resources for future generations. However, the Hanscom Field Airport Environmental Status and Planning Report (ESPR) has not proved to be a viable tool for assisting in that stewardship. It has not proven to be useful in managing the impacts of air traffic at the airport. Although the ESPR review process and report has had some use as a draft plan for Massport expansion of the field and has provided Massport's consultant's view of environmental impact, it has not resulted in any meaningful and tangible controls.

①

The regulatory body, the Executive Office of Environmental Affairs, which oversees the ESPR process, apparently has neither the resources nor the mandate to effectively control the environmental degradation that occurs as a result of ever increasing civilian air traffic at Hanscom Field.

②

Our experience has indicated that EOE A is apparently reluctant to referee the process and its result. During the 2000 ESPR process it was not responsive to the concerns that the ESC, (the Environmental Subcommittee of HATS), the volunteer citizen group that hired consultants and experts of national reputation, raised. The ESC also found that Massport was not sufficiently responsive to community issues and comments. Questions and concerns, supported by well-grounded analysis, still remain unanswered. The growth scenarios presented by Massport were deemed inconsistent with local and regional plans, as was their commitment to stewardship of national resources.

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Recommendations outlined in the Certificate issued by the Secretary of the Executive Office of Environmental Affairs (EOEA) after the 2000 ESPR have not been fully addressed by Massport. Massport has characterized the draft scope of the 2005 ESPR as simply a replication of the same work of the 2000 ESPR. Current MEPA regulations (301 CMR 11.00) are judged to lack the teeth to adequately protect the environment. Meaningful threshold limits, measuring the impacts of proposed development, have been largely eliminated. Changes in the law are called for to restore adequate protection and appropriate enforcement tools.

③

Massport). Massport expects the lease date by next month, November 2005, (as stated at the Hanscom Field Advisory Commission meeting on October 19, 2005 by Massport representatives). Thus, the 2005 ESPR final draft will be completed after the construction of the Crosspoint facility is finished. This means that there will be no meaningful environmental review of a site that is a delineated Zone II by Massachusetts DEP. The impervious surface proposed will increase dramatically by this development (appears to be nearly 100% coverage on schematic drawings) and a fuel farm will be established on this site in a magnitude large enough to drive down the cost of fuel at Hanscom Civilian Airfield.

We believe that the current structure of Massport's ESPR process is inadequate for the reasons stated.

The HATS communities, while committed to participating in a viable planning exercise, depend upon your office and the Governor's office to propose a process that addresses the inadequacies of the current framework.

Sara Mattes / smp
Sara Mattes,
HATS Chair

TOWN OF LINCOLN

LINCOLN TOWN HALL
PO BOX 6353
LINCOLN, MA 01773
TEL: 781-259-2680
FAX 781-259-1577



BOARD OF SELECTMEN
Sarah Cannon Holden, Chair
Sara A. Mattes
Gary A. Taylor

27 October 2005

Secretary Stephen R. Pritchard
Executive Office of Environmental Affairs
Attention: MEPA Office
100 Cambridge Street, Suite 900
Boston, MA 02114

RE: L.G. Hanscom Field - 2005 ESRP Revised Scope Request
EOEA No. 5484/8696
MEPA Analyst: Bill Gage, tel. 617-626-1925
Proponent: Massachusetts Port Authority (Massport)
Filed 9/26/2005

Dear Secretary Pritchard:

The HATS Committee wrote to you earlier this year to let you know that we did not plan to participate in the 2005 ESRP. We have determined, after reviewing our past experience with the 2000 ESRP, the cost to the communities in time and effort far outweigh any marginal value gained either through the discussion or the final document.

The request for modifications to the scope proposed by Director Kinton not only adds nothing of value to the ESRP; it actually gives additional support to our original decision to not participate in the 2005 ESRP.

The scope includes no articulated "State transportation network" that would include air travel. There is no articulated "regional aviation network." Developing a multi-stakeholder (including public involvement) multi-state, multi-modal, long-range transportation plan needs to be a priority item for the State and Massport. Without some meaningful parameters and limits on activities at Hanscom Airport, Massport cannot achieve its goal of returning Hanscom from its present classification as a "Nonhub Primary Commercial Service Airport" to a "General Aviation Reliever Airport."

We suggest to you that the structure of the ESRP is flawed without a clear setting of these limits. HATS concerns are compounded by EOEA- MEPA's apparent failure to hold Massport accountable for noncompliance with prior recommendations by EOEA. Massport has systematically been allowed to ignore scope requirements, even those documented by MEPA. Now, Massport seems to be able to allow up to 660,000 scheduled aviation passengers, scheduled cargo operation accessed by a vaguely referenced road, and a sevenfold increase in jet operations without attendant mitigation or regard to environmental impact.

Additionally, the proposed revised scope does not provide any mechanism for a recent proposal- the Crosspoint proposal- to be subjected to any review. The development proposed by Crosspoint was never anticipated and studied in the ESRP 2000 process. Crosspoint promises the construction on this development within 18 months of the signed lease date (stated in proposal documents by Crosspoint in the possession of

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②

Secretary Ellen Roy Hertzfelder
April 19, 2005

-2-

The four communities would be better served by devoting their efforts to describing environmentally responsible limits for air traffic at Hanscom civilian airport. The expertise of the HATS Environmental subcommittee and the resources of the four HATS communities would be better spent promoting improved regulation rather than perpetuating what the HATS communities have experienced as a meaningless exercise.

As a result, both HATS and the ESC will choose to remain essentially aloof from the 2005 ESRP process. However, HATS would welcome the opportunity to work with Massport to fully implement the directives set forth by MEPA in response to the 2000 ESRP, and to develop a better mechanism to use public resources to find a balance between the needs of the Hanscom Civilian Airport and the historic environment in which it resides.

(8)

Sincerely,



Sara Mattes, Chair
Hanscom Area Towns (HATS)

Cc
Senator Susan Fargo
Senator Robert Havern
Representative Cory Atkins
Representative Jay Kaufman
Representative Charles Murphy
Representative Susan Pope
Representative Tom Stanley
✓ Tom Ennis, Massport
Barbara Patzner, Hanscom Civilian Airport



ShhAir
Box 441
Concord, MA 01742

*Citizens working to Safeguard the Historic
Hanscom Area's Irreplaceable Resources*
www.ShhAir.org

April 3, 2012

Maeve Vallely-Bartlett, Director
Executive Office of Energy and Environmental Affairs (EEA)
Attn: MEPA Office
100 Cambridge St., Suite 900 (9th floor)
Boston MA, 02114
Re: Hanscom Field Environmental Planning and Status Report

Dear Ms. Vallely-Bartlett:

ShhAir (Safeguarding the Historic Hanscom Area Irreplaceable Resources) is a grassroots citizens' organization that has been active in the four towns of Bedford, Concord, Lexington and Lincoln for 20 years, with the mission of protecting the historic resources of our area from undue negative impacts of Hanscom Field.

Over the years we have participated in a number of environmental reviews conducted at Hanscom, and will actively participate in the current scoping process being established for the upcoming ESPR. ←

Shh-1

Our experience has demonstrated the profound importance of this issue, and this process, to the citizens of the towns surrounding Hanscom. Over the years, through Town Meeting resolutions, statements and actions from Boards of Selectmen, public demonstrations and legal challenges, the citizens of our towns have challenged expansion at Hanscom Field. These actions have reflected the great importance that citizens place, not only on the environmental integrity of our communities, but also on our role as the stewards of our historic area's unique role in American history. Both of these core values are severely threatened by the further expansion of activities at Hanscom.

Shh-2

We ask that Massport work together in good faith with the HATS (Hanscom Area Towns) Environmental Subcommittee to develop the kind of scope that will define a planning process that will result in real protection for the important natural and historical environment of the Hanscom area. ←

Shh-3

Margaret Coppe

Margaret Coppe
President, ShhAir Board
12 Barrymeade Drive
Lexington MA 02421
781-862-2637

May 7, 2012

Richard K. Sullivan, Jr., Secretary
Executive Office of Energy and Environmental Affairs
MEPA Office
100 Cambridge Street
Suite 900
Boston MA, 02114
Attn: Bill Gage

RE: Project EEA #5484 / EEA #8696
Proposed Scope for 2012 Hanscom Field Environmental Planning and Status Report (ESPR)

Dear Mr. Sullivan:

As the representative of nineteen families living in the Concord Homes development, which stands some 250 feet from Hanscom Field, I write to comment on Massport's February 2012 Proposed Scope for the 2012 Environmental Planning and Status Report. Few citizens of the Commonwealth have greater first-hand experience of the activities of aircraft at Hanscom Field and even fewer will be impacted as we will be by currently proposed or future growth at Hanscom Field. On any given morning, we already find our conversations at the family table interrupted by aircraft noise, and on any given afternoon, we can find ourselves driven inside by fumes created by aircraft. In light of proposed expansion, our particular concern for the health and safety of the families who live near Hanscom Field is heightened, and we seek your help in assuring a full, thorough, and open assessment of the environmental impact of activities at Hanscom Field both on the ground and in the air. ←

NLC-1

Our chief concern is the emission of fumes, especially those by aircraft using lead-based fuel. The impact of lead on children in particular is well established.¹ In spite of the long-term ban on leaded gasoline for vehicles traveling our roadways, we are unaware of any study conducted by Massport, the FAA, or any other government agency to measure the levels of lead being emitted through ground activity or activity in the air by aircraft on neighborhoods near Hanscom Field. The need for such a study is certainly warranted by the 2008 report of the EPA, which listed Hanscom Field in the top 1% of airport lead emitters nationwide at 33 of 3,414 airports facilities. Anecdotally, our air quality worsens greatly whenever planes stand idling beside their hangars, whenever de-icing is required, and whenever nearby runways are in use. We urge your vigilance in requiring Massport to reduce these emissions.

NLC-2

Our secondary concern lies with the impact of noise on families living adjacent to Hanscom Field. ← We continue to be troubled by the Finding of No Significant Impact by the FAA with regard to plans to double the hangar capacity at Hanscom in order to garage and service large private jets. We understand that this conclusion was drawn based on an impractical standard, defining 65 db DNL as "incompatible with residential land use." At no point has Massport or the FAA measured noise

NLC-3

¹ <http://www.epa.gov/oms/aviation.htm>

levels on our properties even though noise levels from airports have been shown to have a negative impact on the ability of children to learn and on the likelihood of adults to experience stroke.²

We would like to join the four Hanscom-area towns in requesting the following for the 2012 ESPR:

that current and future scenarios for Hanscom Field not exceed the 2010 baseline and that impacts be mitigated from 2010 levels down, ←

NLC-4

that a permanent boundary footprint be established to limit incremental expansion at Hanscom Field, ←

NLC-5

that Massport honor a 30-seat limit for passenger aircraft noted in Massport's own Master Plan rather than a 60-seat limit noted in the noise regulations, and ←

NLC-6

that no commercial or cargo service be permitted in current or future scenarios, ←

NLC-7

We would like to add our own request for your office to require Massport to complete a comprehensive study of the noise levels and air quality caused by fuel emissions on the ground and in the air in the neighborhoods adjacent to Hanscom Field.

Respectfully submitted,



Lynn Vanacore Bloom
Neighborhood Liaison for Concord Homes
25 Fuller Lane
Concord, MA 01742

² Gary Evans and Lorraine Maxwell. <http://www.chchearing.org/noise-center-home/children-and-noise/noise-childrens-health-learning-and-behavior>

Tristan Moore. Study: Airport Noise Increases Risk of Strokes.
http://www.time.com/time/specials/packages/article/0,28804,1929071_1929070_1947782,00.html

Belinda Gower

63 Cedar Way • Concord, MA 01742
Phone: (978) 254-5915 • E-Mail: bgower@mac.com

April 4, 2012

Maeve Valley-Bartlett, Director
Executive Office of Energy and Environmental Affairs (EEA)
Attn: MEPA Office
100 Cambridge St., Suite 900 (9th floor)
Boston MA, 02114
Re: Hanscom Field Environmental Planning and Status Report

Dear Ms. Valley-Bartlett,

As a community member, I wish to express my frustration with the continued increase in air traffic and pollution generated by Hanscom Airport. I live, with my husband and 3 young children, on four acres of meadowlands in Concord. Our property includes protected wetlands and abuts the Minuteman National Historic Park. It is a surreally peaceful setting that is compromised by the thundering sound of jets landing too low and too frequently in our neighborhood. Over the past year, neighbors and I have noticed a significant amplification of noise and jet traffic.

After living abroad with my husband and children for nearly 8 years, we were eager to move back home. We both grew up in Massachusetts and couldn't think of a better place to raise our children than Concord – steeped in history, natural beauty and a strong sense of community rooted in the past—yet devoted to a sustainable and healthy future. We understood that Hanscom was a few miles from our house but because of its historic setting—abutting the Old North Bridge and the Estabrook Woods—we felt this area was protected, sacred almost. We were very wrong in that assumption. We wake and go to bed to the sounds of jet engines. My young children are startled awake in the middle of the night.

Bel-1

Neighbors have moved away as a result of having suffered stress reactions to the onslaught of the pounding jets. They have acquired the many well-documented illnesses that are now inarguably linked with living under a flight path which include cardiovascular disease, hypertension, and stroke. I am aware that Massport is intending to expand its infrastructure for large jets by 572,000 sq ft. and that, according to Massport's own admission, the new large luxury jets will be using the long runway—which already impacts Great Meadows, The Estabrook Woods, numerous schools, the National Park, and historic Concord and Lexington with 80% of the total operations that fly in and out of Hanscom. These resources and communities can't tolerate any increase in impacts.

Bel-2

We look to MEPA to take this environmental scoping process very seriously and request stringent measurements of lead, particulates, Co2 equivalent, and noise contours. We ask that all unhealthy impacts be mitigated thoroughly and appropriately. This historic community that has fought for and

Bel-3

protected—for centuries – the natural public open space that is essential to the health and well-being of all citizens. We owe it to the children and to the next generations to protect this historic landscape from any additional pollution and degradation.

Sincerely,

A handwritten signature in cursive script that reads "Belinda Gower". The signature is written in dark ink and is positioned above the printed name.

Belinda Gower



44 Baker Farm
Lincoln, MA 01773-3004

phone: 781.259.4700
fax: 781.259.4710

e-mail: wwproject@walden.org
website: www.walden.org

Don Henley
Founder and President

Kathi Anderson
Executive Director

RECEIVED

MAY 11 2012

BG

MEPA

May 8, 2012

Richard K. Sullivan, Jr., Secretary
Executive Office of Energy and Environmental Affairs (EEA)
MEPA Office
100 Cambridge St., Suite 900 (9th floor)
Boston MA, 02114
Attn: Bill Gage

RE: Project EEA #5484 / EEA #8696
Proposed Scope for Hanscom Field Environmental Planning and
Status Report (ESPR)

Dear Mr. Sullivan,

As a steward of nationally and internationally significant historic sites and tourist destinations in Concord, located within a two mile radius of Hanscom Field, the Walden Woods Project wishes to submit the following comments regarding Massport's February 2012 Proposed Scope for the 2012 Environmental Planning and Status Report (ESPR).

To date, the greatest threat posed to the Concord historic corridor by Hanscom Field is the noise generated by aircraft activity. Due to the proximity of Walden Pond and Walden Woods to the airport, the thousands of visitors who seek out these sites annually already experience negative impacts from Hanscom's current levels and types of operations. These impacts include interruptions to our outdoor education programs due to the inability of students and teachers to adequately hear presenters. Aircraft noise from Hanscom causes a degradation of the 18th and 19th century experience that people travel from all over the country, and the world, to experience.

WAL-1

We understand that Massport's Proposed Scope for its ESPR, as approved by MEPA, will create a framework for potential future plans for Hanscom Field through 2030. We are concerned that the Proposed Scope is unacceptably open-ended and would give Massport the leeway to move ahead with nearly any plan based on "the demands of the market". The only limitation placed on Hanscom Field appears to be that it cannot exceed 320,000 operations per year – its maximum capacity according to the Master Plan. Given that the historic Walden Pond/Woods area is already adversely impacted by the current 163,000

WAL-2



operations, a doubling of operations would be unacceptably injurious to the visitor's experience. From 1999- 2001, when commercial passenger service was operating out of Hanscom Field (bringing total operations up to 220,000/year), the impacts to Walden Woods were significantly worse. This involved an increase of 60,000 operations. Bringing Hanscom Field to maximum capacity would mean an increase of 160,000 additional operations.

To allow Massport to rely on "maximum capacity" and "demands of the market" as the key factors for guiding its plans for Hanscom Field will undermine the invaluable educational and recreational experiences these historic sites offer the public.

WAL-3

Therefore, the Walden Woods Project supports the recommendations of the Hanscom-area towns, via the HATS Environmental Subcommittee's comments submitted to MEPA, which we believe will provide more definition to the 2012 ESPR Scope, and a more acceptable future for the historic sites that we are responsible for preserving.

Specifically, we concur with these recommendations from the HATS Environmental Subcommittee:

- Current and future scenarios for Hanscom Field should not exceed the 2010 baseline, and impacts should be mitigated from 2010 levels down.
- A permanent boundary footprint should be established to limit incremental expansion at Hanscom Field (such as Massport's recent bid to purchase new airside Naval property).
- Massport should use the 30-seat limit for passenger aircraft noted in the Master Plan, not the 60-seat limit noted in the Noise Regulations.
- No new commercial or cargo service should be studied in current or future scenarios.

WAL-4

WAL-5

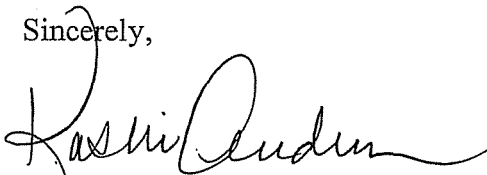
WAL-6

WAL-7

We respectfully request that you direct Massport to implement the HATS Environmental Subcommittee's recommendations in the finalized Scope for the 2012 ESPR. Only by doing so, will it be possible to begin to work towards achieving a better balance between Massport's plans and the needs of the historic and the natural resources preservation community.

Thank you for your time and consideration.

Sincerely,



Kathi R. Anderson
Executive Director
Walden Woods Project



CONCORD
MUSEUM

200 LEXINGTON ROAD
POST OFFICE BOX 146
CONCORD, MA
01742-0146

TELEPHONE: 978-369-9763
FAX: 978-369-9660

www.concordmuseum.org

RECEIVED

MAY 11 2012

May 9, 2012

Richard K. Sullivan, Jr., Secretary
Executive Office of Energy and Environmental Affairs (EEA)
MEPA Office
100 Cambridge St., Suite 900 (9th floor)
Boston MA, 02114
Attn: Bill Gage

RE: Project EEA #5484 / EEA #8696
Proposed Scope for Hanscom Field Environmental Planning and Status Report (ESPR)

Dear Mr. Sullivan,

As stewards of nationally and internationally significant historic sites and tourist destinations in Concord, located within a two mile radius of Hanscom Field, the Concord Museum submits the following remarks on Massport's February 2012 Proposed Scope for the 2012 Environmental Planning and Status Report (ESPR).

To date, the greatest threat posed to the Concord historic corridor by Hanscom Field is the noise generated by aircraft activity. Due to proximity of these historic landmarks to the airport, the thousands of visitors who seek out the sites annually already experience negative impacts from Hanscom's current levels and types of operations. For some of us, these impacts include interruptions on our tours and the inability of our visitors to hear interpreters; for all of us, they cause a degradation of the 18th and 19th century experience that people travel from all over the country, and the world, to experience.

MUS-1

The Concord Museum understands that Massport's Proposed Scope for its ESPR, as approved by MEPA, will create a framework for potential future plans for Hanscom Field through 2030. The Museum is concerned that the Proposed Scope is unacceptably open-ended and would give Massport the leeway to move ahead with nearly any plan based on "the demands of the market." The only limitation placed on Hanscom Field appears to be that it cannot exceed 320,000 operations per year — its maximum capacity according to the Master Plan. Given that the historic area is already adversely impacted by the current 163,000 operations, a doubling of operations would be unacceptably injurious to the visitor's experience and to the sanctity of the sites. The Museum speaks from experience. From 1999-2001, when certificated commercial passenger service was operating out of Hanscom Field

MUS-2

MUS-3

(bringing total operations up to 220,000/year), the impacts on the sites and visitor experience were significantly worse – this, with “only” an increase of 60,000 operations. Bringing Hanscom Field to maximum capacity would mean an increase of 160,000 additional operations.

To allow Massport to rely on “maximum capacity” and “demands of the market” as the key factors for guiding its plans for Hanscom Field will lead to the irreversible undermining of the invaluable experiences these historic sites offer the public.

Therefore, the Museum whole-heartedly supports the recommendations of the Hanscom-area towns, via the HATS Environmental Subcommittee’s comments submitted to MEPA, which the Museum believes will provide more definition to the 2012 ESPR Scope, and a more acceptable future for the historic sites that we are responsible for preserving.

Specifically, the Museum concurs with these recommendations from the HATS Environmental Subcommittee:

- Current and future scenarios for Hanscom Field should not exceed the 2010 baseline and impacts should be mitigated from 2010 levels down. MUS-4
- A permanent boundary footprint be established to limit incremental expansion at Hanscom Field (such as Massport’s recent bid to purchase new airside Naval property). MUS-5
- Massport should use the 30-seat limit for passenger aircraft noted in the Master Plan, not the 60-seat limit noted in the Noise Regulations. MUS-6
- No new commercial or cargo service should be studied in current or future scenarios. MUS-7

The Museum respectfully requests that you direct Massport to implement the HATS Environmental Subcommittee’s recommendations in the finalized Scope for the 2012 ESPR. Only by doing so, will it be possible to begin to work towards achieving a better balance between Massport’s plans and the needs of the historic and the natural resources preservation community.

Thank you for your time and consideration.

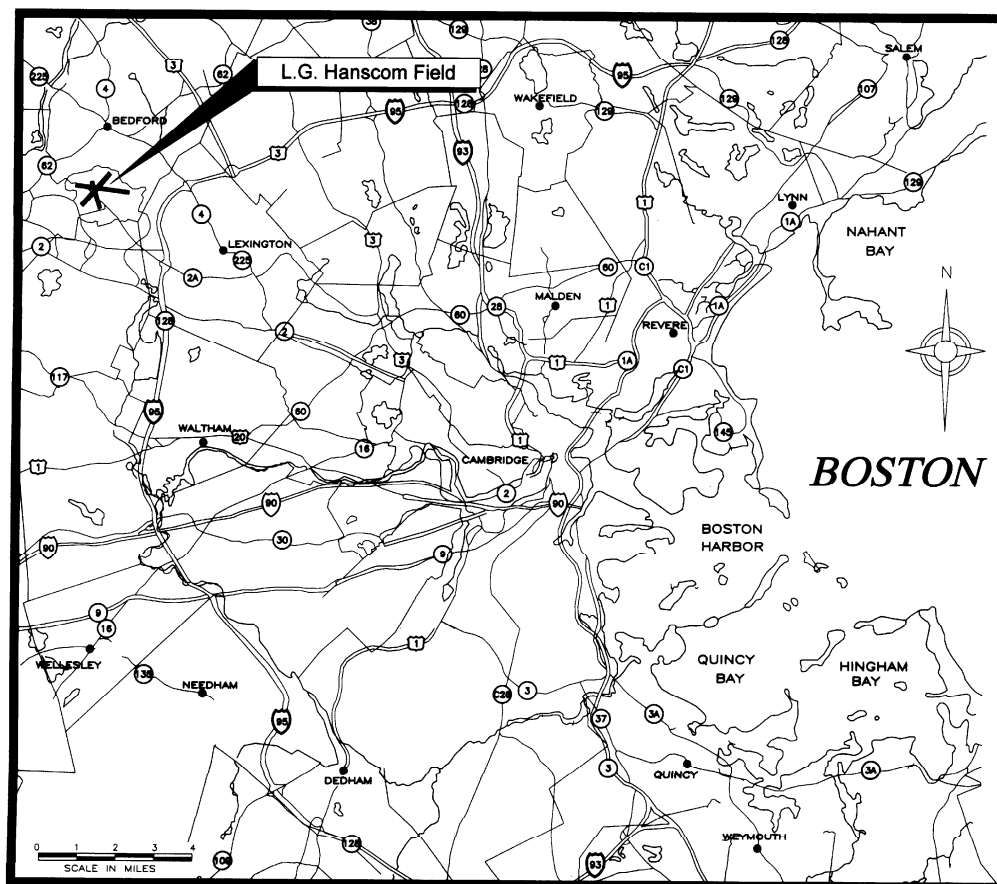
Sincerely,



Peggy Burke
Executive Director

Appendix B Airport Layout Plan

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Location Map

Index of Sheets

Title Sheet	1
Existing Conditions	2
Ultimate Airport Layout Plan	3
Terminal Area Plan - Civil Air Terminal	4
Terminal Area Plan - East Ramp	5
Plans/Profiles, Runway Approaches	6
Part 77 Imaginary Surfaces Plan	7
Existing Land Use	8

L. G. Hanscom
Field
Bedford, MA



Airport Layout Plan

Massachusetts Port Authority Approval

Approved		Interim CEO and Executive Director	Date	7/24/11
Approved		Director of Aviation	Date	7-26-2011
Approved		Director of Capital Programs and Environmental Affairs	Date	7-26-2011

Revisions

Date	By	Remarks

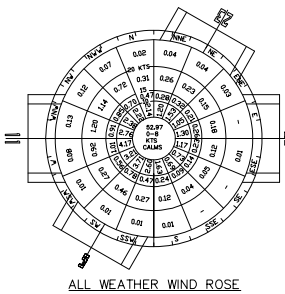
Prepared By



Massachusetts Port Authority
Capital Programs Department
One Harborside Drive
East Boston, MA 02128

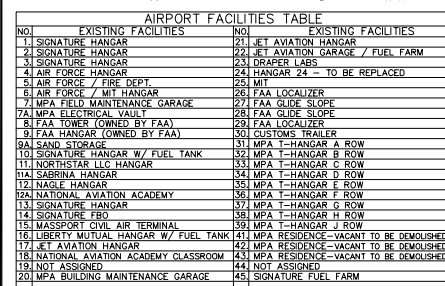
Date July 26, 2011

RECEIVED
SEP 01 2011
MASSPORT AUTHORITY
EP&D DEPARTMENT



CROSSWIND COVERAGE (% OF TIME)			
RUNWAY	ALL WEATHER (IFR WEATHER)		
	15 KTS	10.5 KTS	
11-29	97.84 (13.62)%	93.91 (13.05)%	
5-23	96.47 (13.72)%	91.81 (13.39)%	
COMBINED	98.95 (13.89)%	97.10 (13.76)%	
VFR WEATHER = 86.04%		IFR WEATHER = 13.96%	

SOURCE: NATIONAL OCEANIC AND ATMOSPHERIC
ADMINISTRATION NATIONAL CLIMATIC
CENTER/ASHEVILLE, NORTH CAROLINA
PERIOD: 1961-1970 (87,589 TOTAL OBSERVATIONS)



LEGEND	
EXISTING	
	AIRPORT PROPERTY LINE
	TOWN BOUNDARY LINE
	AIRPORT SECURITY FENCING
	TREE LINE
	AIRPORT REFERENCE POINT (A.R.P.)
	AIRPORT APRON AREA
	EXISTING PAVEMENT
	AIRPORT UNPAVED AREA
	GROUND CONTOURS
	RUNWAY SAFETY AREA (RSA)
	RUNWAY PROTECTION ZONE (RPZ)
	RUNWAY VISIBILITY ZONE (RVZ)
	RUNWAY OBJECT FREE AREA (ROFA)
	AVIATION FACILITY STRUCTURE
	FEDERAL LEASE AREAS

	RUNWAY DATA			
	RUNWAY 11-29		RUNWAY 5-23	
	EXISTING	ULTIMATE	EXISTING	ULTIMATE
EFFECTIVE GRADIENT (%)	0.1285		0.00	
INSTRUMENT RUNWAY	YES		NO	
RUNWAY LIGHTING	HIRL		MIRL	
PAVEMENT STRENGTH	785,1000,1900T		725,1170	
TYPE OF PAVEMENT	ASPHALT BROOD		ASPHALT OBT-GROVED	
RUNWAY LENGTH	7,501'		5,108'	
RUNWAY WIDTH	150'		150'	
FAR PART 77	R/W 11' R/W 29		R/W 5' R/W 23	
APPROACH SURFACES	150' 150' 150' 150'		201' 141'	
RUNWAY END COORDINATES, IN 1983	29 29 29 29		29 29 29 29	
VISUAL AIDS	WAS-VAS WAS-VAS WAS-VAS		VAS-VAS VAS-VAS VAS-VAS	
NAVIGATION AIDS	ILS,RVR, NDB		VOR-23	VOR-23
RSA DIMENSIONS				
LENGTH BEYOND RW END	1,000	1,000	869' CL, 102' WEST 869' EAST	890'
WIDTH	500'	500'	500'	500'
RUNWAY MARKING	PRECISION	PRECISION	VISUAL	NON PRECISION
OBJECT FREE AREA				
LENGTH BEYOND RW END	800'	800'	800'	800'
WIDTH	1,000'	1,000'	1,000'	1,000'
TDZ ELEVATION	132.6'	128.4'	N/A	128.6'

AIRPORT DATA		
	EXISTING	ULTIMATE
AIRPORT ELEVATION (NAVD88)	132.26'	
AIRPORT REFERENCE POINT	LAT.42°-25'-12" LONG.71°-17'-22"	
MEAN MAX. TEMP. OF HOTTEST MONTH	82°F	
AIRPORT AND TERMINAL NAVIGATION AIDS	ILS,ASR,FA,PAR,VAS	
AIRPORT TYPE (AS PER FAA NPAS)		
AIRPORT REFERENCE CODE	C-III	
DESIGN AIRCRAFT	G-W	
WIND COVERAGE	98.95%	
TAXIWAY LIGHTING*	MIL	

* TAXIWAYS R & N NOT LIGHTED

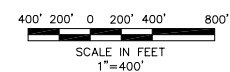
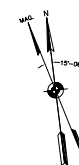
RUNWAY SAFETY AREAS (RSA)
RSA FOR RUNWAY 11-29 AS PER FAA GUIDELINES
RSA FOR ENDS OF RUNWAY 5-23 AS PER FAA
APPROVED 139 MANUAL (APPROVED 8/24/05)

MODIFICATION OF STANDARDS				
DESCRIPTION	EXISTING/ PLANNED	STANDARD	REMARKS	DATE APPROVED
1. Dual absorption filter 2. 1000 Hz. low pass filter 3. 1000 Hz. high pass filter	2x1 1000 Hz. 1000 Hz. low pass 1000 Hz. high pass	2x1 1000 Hz. 1000 Hz. low pass 1000 Hz. high pass	The 1000 Hz. low pass filter is to be installed in the 1000 Hz. high pass filter.	03/03/2011
1. Tuning fork assembly	2K type	1000 Hz.	The tuning fork assembly is to be installed in the 1000 Hz. high pass filter.	03/03/2011
1. Battery 8V 8Ah battery (see battery)	8V 8Ah 1000 Hz. low pass 1000 Hz. high pass	1000 Hz. 1000 Hz. low pass 1000 Hz. high pass	The battery is to be installed in the 1000 Hz. high pass filter.	03/03/2011
1. New definition in Navy 03/22 Part 77 Annex	1000 Hz. low pass 1000 Hz. high pass	1000 Hz. 1000 Hz. low pass 1000 Hz. high pass	The definition in Navy 03/22 Part 77 Annex is to be installed in the 1000 Hz. high pass filter.	03/03/2011
1. New definition in Navy 03/22 Part 77 Annex	1000 Hz. low pass 1000 Hz. high pass	1000 Hz. 1000 Hz. low pass 1000 Hz. high pass	The definition in Navy 03/22 Part 77 Annex is to be installed in the 1000 Hz. high pass filter.	03/03/2011
1. New definition in Navy 03/22 Part 77 Annex	1000 Hz. low pass 1000 Hz. high pass	1000 Hz. 1000 Hz. low pass 1000 Hz. high pass	The definition in Navy 03/22 Part 77 Annex is to be installed in the 1000 Hz. high pass filter.	03/03/2011

Definition:
 (Name of Operator) certifies that all report elements shown on this RPT are in compliance with applicable conditions in the current edition of FSA Advisory Circular 001/03/01 as noted in table entitled, "Applicable Conditions".

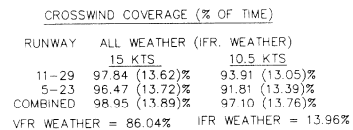
NOTES:

1. SOURCE OF BASEMAP FROM APRIL 2001
FLYOVER BY CHAS. H. SELLS INC.

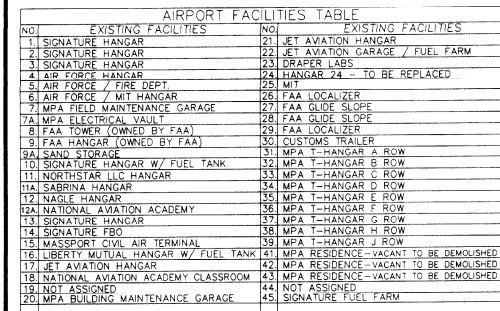


REV. NO.	DATE	DESCRIPTION	MADE BY	CHK. BY	APPRO. BY
MASSACHUSETTS PORT AUTHORITY BOSTON, MASSACHUSETTS					
L.G. HANSCOM FIELD BEDFORD, MA					
L.G. HANSCOM AIRPORT LAYOUT PLAN EXISTING CONDITIONS					
CAPITAL PROGRAMS DEPARTMENT ONE HARBORSIDE DRIVE, EAST BOSTON, MA. 02128-2809					
DES. BY: TWE		CHKD. BY: JAG		LOC. CODE:	
DWN. BY: GUD					
SCALE: 1"=400'		APPROVED: JAG		DATE: 7/26/2011	
				DWG. NO.:	
SHEET 2 OF 8		MPA PROJECT NO.			

PLOTTED: 7/26/11 BY: GDTULLIO LAST SAVED: 7/26/11 BY: GDTULLIO
DRAWING: T:\GIS\GFILES\HANSCOM\AIRPORT_LAYOUT_PLAN\2009_HANSCOM_AIRPORT_LAYOUT_PLAN_01.dwg



SOURCE: NATIONAL OCEANIC AND ATMOSPHERIC
ADMINISTRATION NATIONAL CLIMATIC
CENTER/ASHEVILLE, NORTH CAROLINA
PERIOD: 1961-1970 (87,589 TOTAL OBSERVATIONS)



LEGEND	
EXISTING	ULTIMATE
	AIRPORT PROPERTY LINE
	TOWN BOUNDARY LINE
	AIRPORT SECURITY FENCING
	TREE LINE
	AIRPORT REFERENCE POINT (A.R.P.)
	AIRPORT APRON AREA
	EXISTING PAVEMENT
	FUTURE TAXIWAYS
	AIRPORT UNPAVED AREA
	GROUND CONTOURS
	RUNWAY SAFETY AREA (RSA)
	RUNWAY PROTECTION ZONE (RPZ)
	RUNWAY OBSTACLE ZONE (RVZ)
	RUNWAY OBJECT FREE AREA (ROFA)
	AIRPORT AVIATION OR COMPATIBLE LAND USE
	AVIATION FACILITY/STRUCTURE
	FEDERAL LEASE AREAS (AVAILABLE FOR FUTURE AVIATION USE)

RUNWAY DATA												
	RUNWAY 11-23						RUNWAY 5-23					
	EXISTING			ULTIMATE			EXISTING			ULTIMATE		
EFFECTIVE GRADIENT (%)	0.1285			SAME			0.00			SAME		
INSTRUMENT RUNWAY	YES			SAME			NO			SAME		
RUNWAY LIGHTING	HIRL			SAME			MIRL			SAME		
PAVEMENT STRENGTH	785,1000,1900			SAME			1225,1170			SAME		
TYPE OF PAVEMENT	ASPHALT GRADED			SAME			ASPHALT GRADED			SAME		
RUNWAY LENGTH	7,001'			SAME			5,106'			SAME		
	150'			SAME			150'			SAME		
FAR PART 77												
APPROACH SURFACES	R/W 11'	R/W 23'	R/W 11'	R/W 23'	R/W 23'	R/W 23'	R/W 5'	R/W 23'	R/W 5'	R/W 23'	R/W 23'	R/W 23'
	50' 1/40:1	50' 1/40:1	SAME	SAME	SAME	SAME	20:1	34:1	SAME	34:1	SAME	34:1
RUNWAY END COORDINATES	21° 47' 40" N	21° 47' 40" N	SAME	SAME	SAME	SAME	21° 47' 40" N	21° 47' 40" N	SAME	SAME	SAME	SAME
VISUAL AIDS	LSR, RVR, NDB	LSR, RVR, NDB	SAME	SAME	SAME	SAME	VAS-4, RCL, VAS-4, RCL	VAS-4, RCL	SAME	SAME	SAME	SAME
NAVIGATION AIDS	ILS, RVR, NDB	ILS, NDB	SAME	SAME	SAME	SAME	VOR-23	VOR-23	SAME	SAME	SAME	SAME
RSA DIMENSIONS												
LENGTH BEYOND RW END	1,000'	1,000'	SAME	SAME	SAME	SAME	523' WEST, 845' EAST	890'	SAME	SAME	SAME	SAME
WIDTH	500'	500'	SAME	SAME	SAME	SAME	500'	500'	SAME	SAME	SAME	SAME
RUNWAY MARKING	PRECISION	PRECISION	SAME	SAME	SAME	SAME	USUAL	NO PRECISION	SAME	SAME	SAME	SAME
OBJECT FREE AREA												
LENGTH BEYOND RW END	1,000'	1,000'	SAME	SAME	SAME	SAME	890' IL, 523' WEST, 845' EAST	890'	SAME	SAME	SAME	SAME
WIDTH	800'	800'	SAME	SAME	SAME	SAME	800'	800'	SAME	SAME	SAME	SAME
TDZ ELEVATION	132.6'	126.4'	SAME	SAME	SAME	SAME	N/A	128.6'	SAME	SAME	SAME	SAME

AIRPORT DATA			
	EXISTING	ULTIMATE	
AIRPORT ELEVATION (NAVDB88)	132'26"	SAME	
AIRPORT REFERENCE POINT	LAT. 42°-28'-12" LONG. 71°-17'-22"	SAME	
MEAN MAX. TEMP. OF HOTTEST MONTH	82°F	SAME	
AIRPORT AND TERMINAL NAVIGATION AIDS	ILS, SALS, PAR, VAS	SAME	
AIRPORT TYPE (AS PER FAA NPAS)	C	SAME	
AIRPORT REFERENCE CODE	CR III	SAME	
DESIGN AIRCRAFT	C - V	SAME	
WIND COVERAGE	QR 95%	SAME	
TAXIWAY LIGHTING*	MFL	SAME	

* TAXIWAYS R & N NOT LIGHTED

RUNWAY SAFETY AREAS (RSA)
RSA FOR RUNWAY 11-29 AS PER FAA GUIDELINES
RSA FOR ENDS OF RUNWAY 5-23 AS PER FAA
APPROVED 139 MANUAL (APPROVED 8/24/05)

MASSACHUSETTS PORT AUTHORITY
BOSTON, MASSACHUSETTS

APPROVED BY: *[Signature]*
INTERIM
AND EXECUTIVE DIRECTOR
[Signature]
DIRECTOR OF AVIATION

[Signature]
DIRECTOR OF CAPITAL PROGRAMS
AND ENVIRONMENTAL AFFAIRS

DATE: 7-26-2011

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
NEW ENGLAND REGION

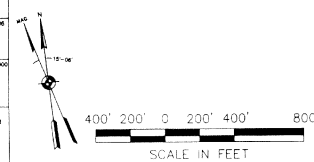
APPROVED BY: *Robert M. R.*
MANAGER OF AIRPORTS

DATE: 8/24/2011

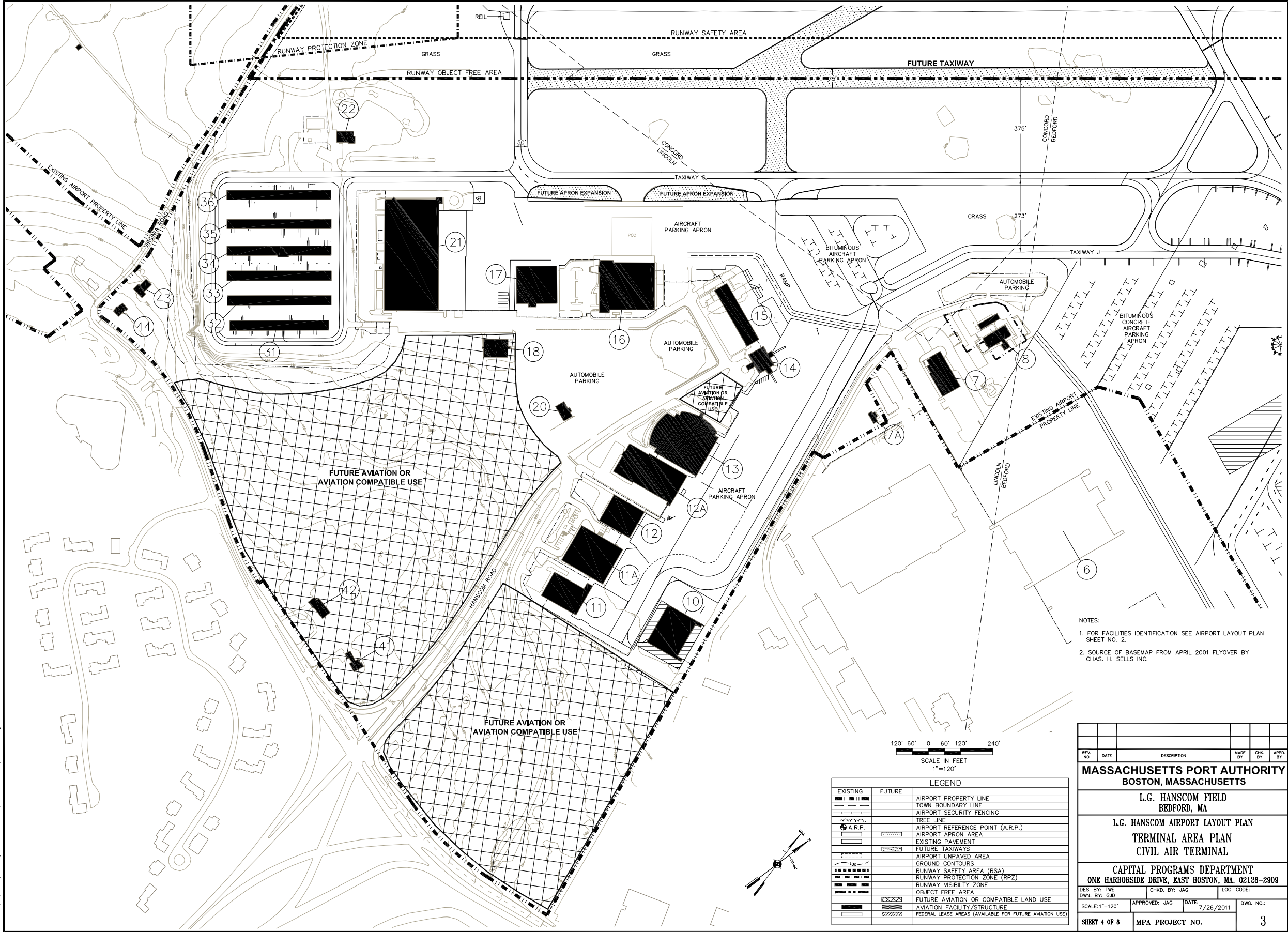
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NOTES:

1. SOURCE OF BASEMAP FROM APRIL 2001 FLYOVER BY CHAS. H. SELLS INC.



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MASSACHUSETTS PORT AUTHORITY BOSTON, MASSACHUSETTS					
L.G. HANSCOM FIELD BEDFORD, MA					
L.G. HANSCOM AIRPORT LAYOUT PLAN ULTIMATE AIRPORT LAYOUT PLAN					
CAPITAL PROGRAMS DEPARTMENT ONE BARBERSIDE DRIVE, EAST BOSTON, MA. 02128-2909					
DES. BY: TWE		CHKD. BY: JAG		LOC. CODE:	
DWG. BY: GJD					
SCALE: 1"=400'	APPROVED: JAG		DATE	DWG. NO.:	
			7/26/2011		
SHEET 3 OF 8		MPA PROJECT NO.			2



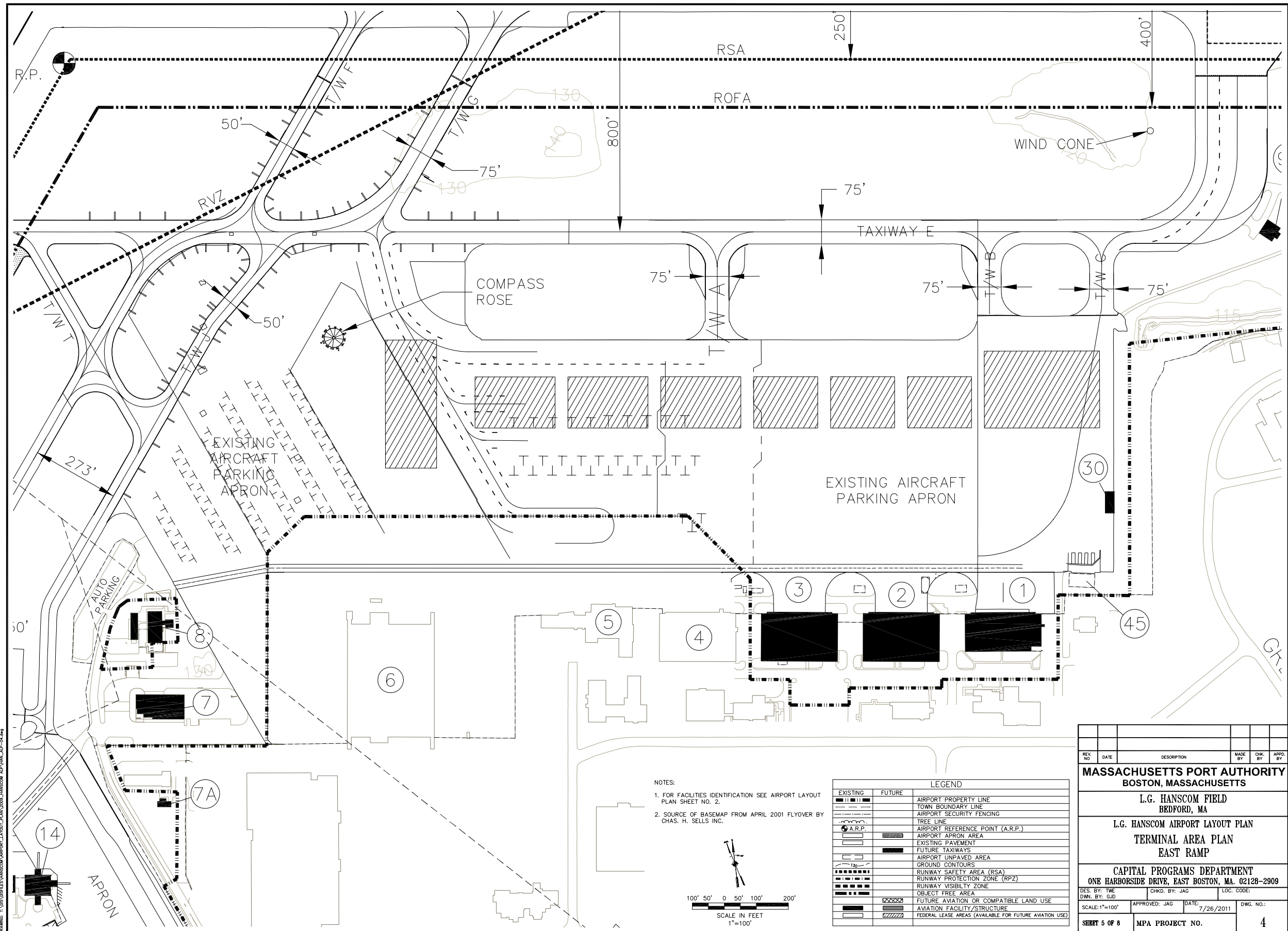
- NOTES:
1. FOR FACILITIES IDENTIFICATION SEE AIRPORT LAYOUT PLAN SHEET NO. 2.
 2. SOURCE OF BASEMAP FROM APRIL 2001 FLYOVER BY CHAS. H. SELLS INC.

120' 60' 0 60' 120' 240'
SCALE IN FEET
1"=120'

LEGEND	
EXISTING	FUTURE
	AIRPORT PROPERTY LINE
	TOWN BOUNDARY LINE
	AIRPORT SECURITY FENCING
	TREE LINE
	AIRPORT REFERENCE POINT (A.R.P.)
	AIRPORT APRON AREA
	EXISTING PAVEMENT
	FUTURE TAXIWAYS
	AIRPORT UNPAVED AREA
	GROUND CONTOURS
	RUNWAY SAFETY AREA (RSA)
	RUNWAY PROTECTION ZONE (RPZ)
	RUNWAY VISIBILITY ZONE
	OBJECT FREE AREA
	FUTURE AVIATION OR COMPATIBLE LAND USE
	AVIATION FACILITY/STRUCTURE
	FEDERAL LEASE AREAS (AVAILABLE FOR FUTURE AVIATION USE)

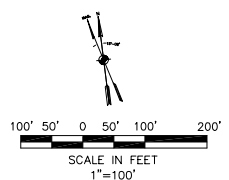
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MASSACHUSETTS PORT AUTHORITY BOSTON, MASSACHUSETTS						
L.G. HANSCOM FIELD BEDFORD, MA						
L.G. HANSCOM AIRPORT LAYOUT PLAN TERMINAL AREA PLAN CIVIL AIR TERMINAL						
CAPITAL PROGRAMS DEPARTMENT ONE HARBORSIDE DRIVE, EAST BOSTON, MA. 02128-2909						
DES. BY: TWE	CHKD. BY: JAG	LOC. CODE:				
DWN. BY: GJD	APPROVED: JAG	DATE: 7/26/2011	DWG. NO.:			
SHEET 4 OF 8		MPA PROJECT NO.		3		

PLOTTED: 7/26/11 BY: GJTDLLD. LAST SAVED: 7/26/11 BY: GJTDLLD.
DRAWING: T:\GAS\GJTDLLD\HANSCOM AIRPORT LAYOUT PLAN\2009-HANSCOM AIRPORT LAYOUT-03.dwg



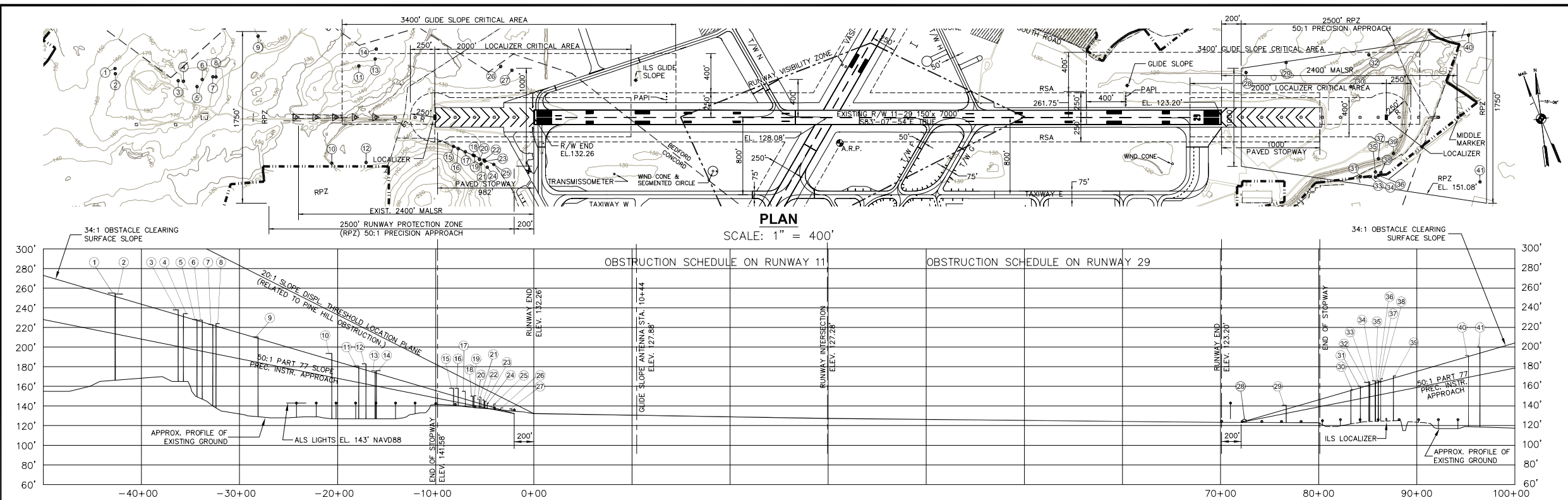
PLOTTED: 7/26/11 BY: GUTIELLO, LAY: 7/26/11 BY: GUTIELLO
DRAWING: T:\GAS\PROJECTS\HANSKOM AIRPORT LAYOUT PLAN\2009-HANSKOM AUP\PLAN_AUP-04.dwg

- NOTES:
1. FOR FACILITIES IDENTIFICATION SEE AIRPORT LAYOUT PLAN SHEET NO. 2.
 2. SOURCE OF BASEMAP FROM APRIL 2001 FLYOVER BY CHAS. H. SELLS INC.

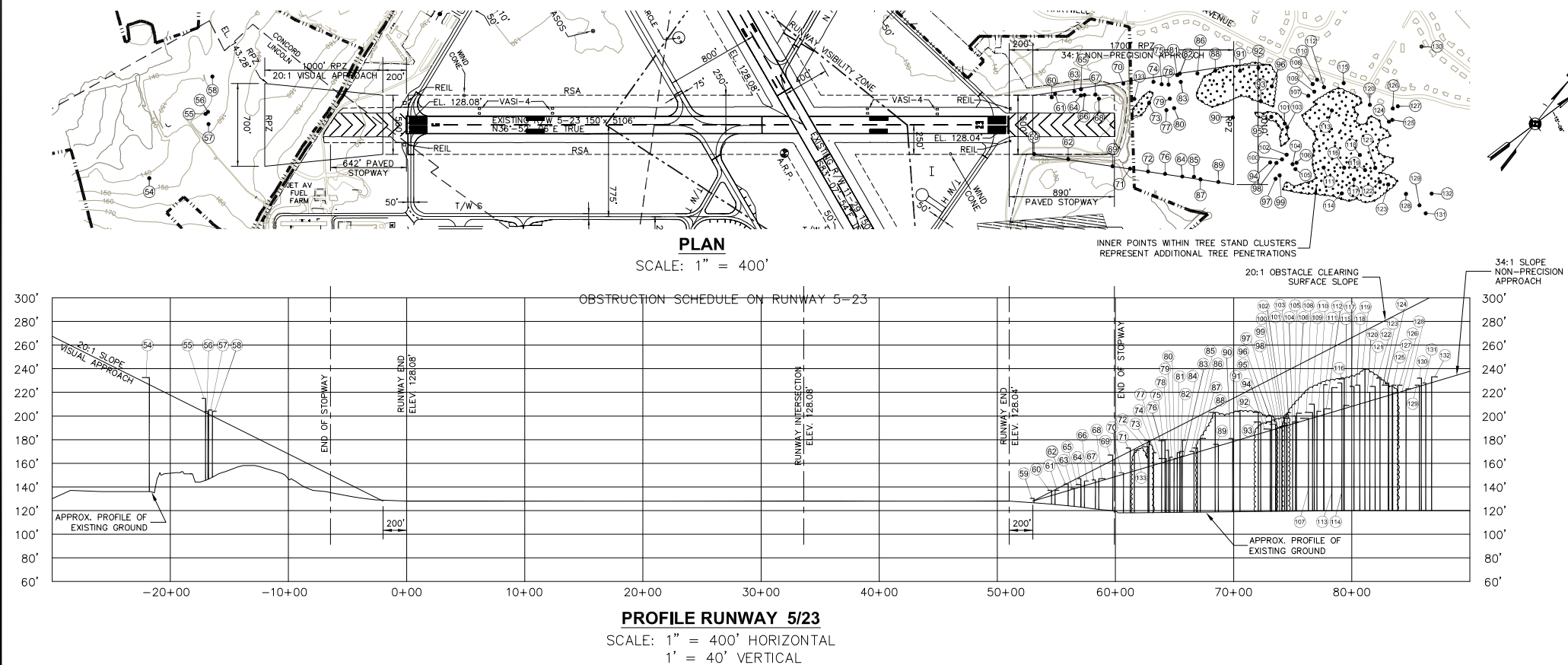


LEGEND	
EXISTING	FUTURE

REV	NO.	DATE	DESCRIPTION	MADE BY	CHK BY	APPRO BY
MASSACHUSETTS PORT AUTHORITY BOSTON, MASSACHUSETTS						
L.G. HANSKOM FIELD BEDFORD, MA						
L.G. HANSKOM AIRPORT LAYOUT PLAN TERMINAL AREA PLAN EAST RAMP						
CAPITAL PROGRAMS DEPARTMENT ONE HARBORSIDE DRIVE, EAST BOSTON, MA. 02128-2909						
DES. BY: TWE	CHKD. BY: JAG	LOC. CODE:				
DWN. BY: GJD	APPROVED: JAG	DATE: 7/26/2011	DWG. NO.:			
SHEET 5 OF 8		MPA PROJECT NO.		4		

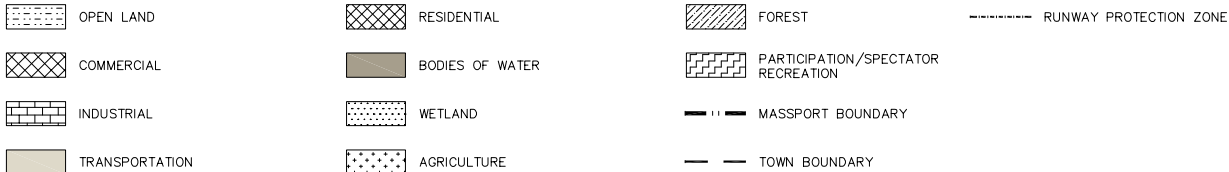
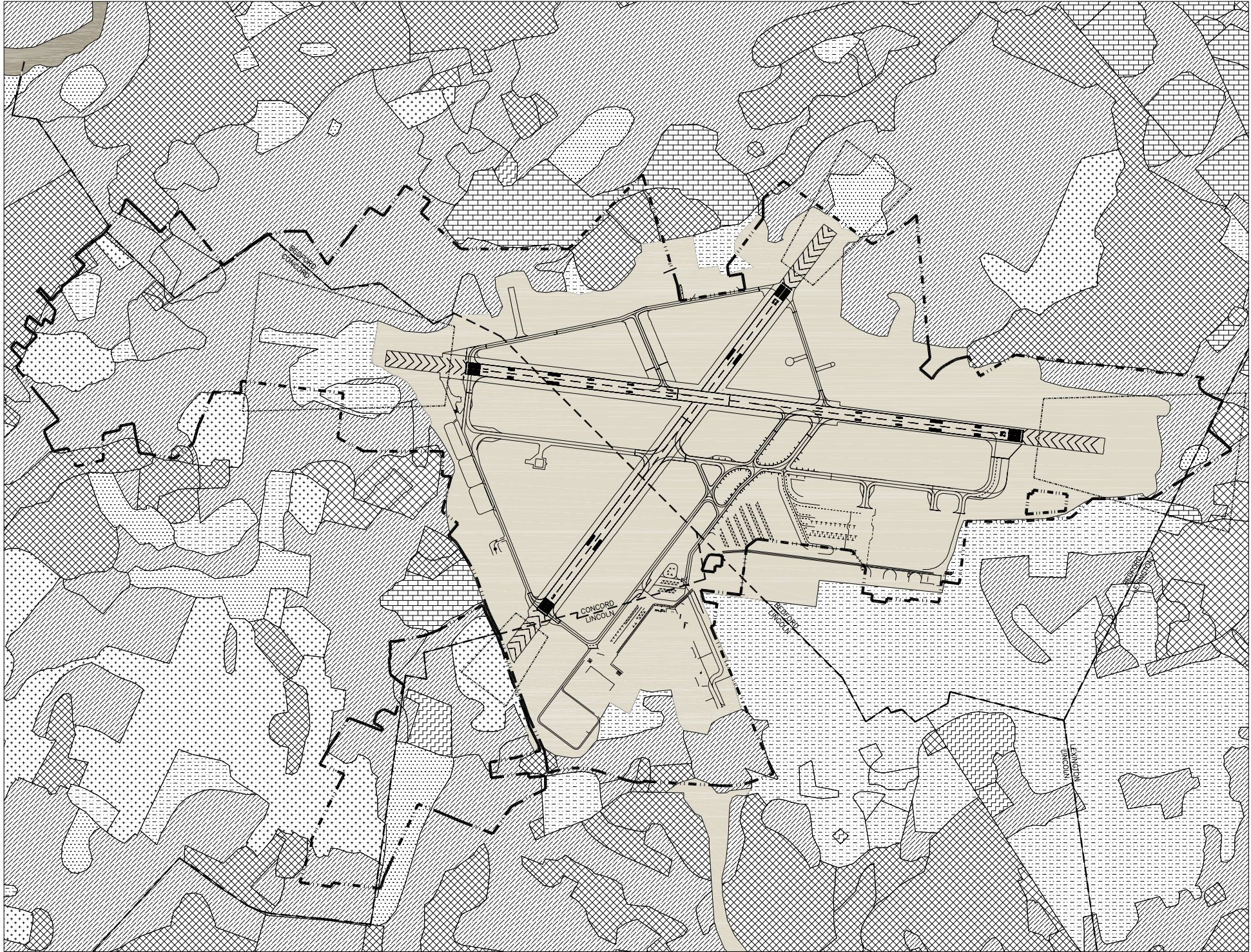


PROFILE RUNWAY 11/29
SCALE: 1" = 400' HORIZONTAL
1' = 40' VERTICAL



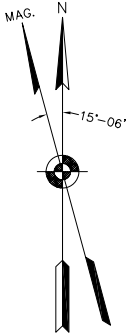
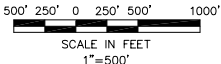
REV.	DATE	DESCRIPTION				MADE	CHK.	APPRO.	
NO.						BY	BY	BY	
MASSACHUSETTS PORT AUTHORITY BOSTON, MASSACHUSETTS									
L.G. HANSCOM FIELD BEDFORD, MA									
L.G. HANSCOM AIRPORT LAYOUT PLAN PLANS/PROFILES, RUNWAY APPROACHES									
CAPITAL PROGRAMS DEPARTMENT ONE HARBOURSIDE DRIVE, EAST BOSTON, MA. 02128-2909									
DES. BY: TWE		CHKD. BY: JAG				LOC. CODE:			
DWN. BY: GJD									
SCALE: AS NOTED		APPROVED: JAG		DATE: 7/26/2011		DWC. NO.:			
SHEET 6 OF 8		MPA PROJECT NO.				5			

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DRAWING: T:\GIS\PROJECTS\HANSKOM AIRPORT LAYOUT_PLAN\2009-HANSKOM_AIRPORT_LAYOUT_PLAN.dwg



NOTES:

1. DEPICTED LAND USE AREAS OBTAINED FROM THE 2002 MASSGIS LAND USE DATALAYER.
2. FOR AIRCRAFT NOISE CONTOURS, REFER TO THE MOST RECENT ENVIRONMENTAL STATUS PLANNING REPORT (ESPR) FOR HANSKOM FIELD. THE ESPR IS AVAILABLE THROUGH THE MASSACHUSETTS PORT AUTHORITY.



REV.	NO.	DATE	DESCRIPTION	MADE BY	CHK. BY	APPR. BY
MASSACHUSETTS PORT AUTHORITY BOSTON, MASSACHUSETTS						
L.G. HANSKOM FIELD BEDFORD, MA						
L.G. HANSKOM AIRPORT LAYOUT PLAN						
EXISTING LAND USE PLAN						
CAPITAL PROGRAMS DEPARTMENT ONE HARBORSIDE DRIVE, EAST BOSTON, MA. 02128-2909						
DES. BY: TWE DWN. BY: GJD		CHKD. BY: JAG		LOC. CODE:		
SCALE: 1"=500'		APPROVED: JAG		DATE: 7/26/2011		DWG. NO.:
SHEET 6 OF 8		MPA PROJECT NO.			7	

Appendix C Ground Transportation

Appendix C

Ground Transportation

C-1	2013 Hanscom Field Travel Questionnaire	C-4
	Instructions	C-5
	Employee & Student Survey Questions	C-5
	Employee & Student Survey Responses	C-17
C-2	2012 Intersection Turning Movement Counts	C-45
	<u>MORNING PEAK HOURS</u>	
	#1 Route 4-225 & Hartwell Avenue, Lexington	C-46
	#2 Massachusetts Avenue & Route 2A, Lexington	C-51
	#3 Old Massachusetts Avenue & Route 2A, Lexington	C-56
	#4 Airport Road & Route 2A, Lexington	C-61
	#5 Hanscom Drive & Old Bedford Road, Lincoln	C-66
	#6 Hanscom Drive & Route 2A, Lincoln	C-71
	#7 Bedford Road & Route 2A, Lincoln	C-76
	#8 Cambridge Turnpike Cut-Off, Brooks Road, Lexington Road & Route 2A, Lincoln/Concord	C-81
	#9 Old Bedford Road & Lexington Road (Route 2A), Concord	C-86
	#10 Old Bedford Road & Virginia Road, Concord	C-91
	#11 Old Bedford Road & Route 62, Concord	C-96
	#12 Hartwell Road & Route 62, Bedford	C-101
	#13 South Road & Hartwell Road, Bedford	C-106
	#14 Route 4-225 & Route 62, Bedford	C-111
	#15 Great Road (Route 4-225), Springs Road & South Road, Bedford	C-116
	#16 South Road, Loomis Street & Railroad Avenue, Bedford	C-121
	<u>AFTERNOON PEAK HOURS</u>	
	#1 Route 4-225 & Hartwell Avenue, Lexington	C-126
	#2 Massachusetts Avenue & Route 2A, Lexington.....	C-131
	#3 Old Massachusetts Avenue & Route 2A, Lexington	C-136
	#4 Airport Road & Route 2A, Lexington	C-141
	#5 Hanscom Drive & Old Bedford Road, Lincoln	C-146
	#6 Hanscom Drive & Route 2A, Lincoln	C-151
	#7 Bedford Road & Route 2A, Lincoln	C-156
	#8 Cambridge Turnpike Cut-Off, Brooks Road, Lexington Road & Route 2A, Lincoln/Concord	C-161
	#9 Old Bedford Road & Lexington Road (Route 2A), Concord	C-166
	#10 Old Bedford Road & Virginia Road, Concord	C-171
	#11 Old Bedford Road & Route 62, Concord	C-176

	#12 Hartwell Road & Route 62, Bedford	C-181
	#13 South Road & Hartwell Road, Bedford	C-186
	#14 Route 4-225 & Route 62, Bedford	C-191
	#15 Great Road (Route 4-225), Springs Road & South Road, Bedford	C-196
	#16 South Road, Loomis Street & Railroad Avenue, Bedford	C-201
C-3	2012 Automatic Traffic Recorder (ATR) Counts	C-206
	Location A: Route 2A, east of Airport Road (Lexington)	C-207
	Location B: Bedford Road, south of Route 2A (Lincoln)	C-243
	Location C: Cambridge Turnpike Cut-Off, southwest of Lexington Road (Lincoln, near Concord line) ...	C-279
	Location D: Old Bedford Road, north of Virginia Road (Concord)	C-315
	Location E: Route 62, west of Old Bedford Road (Concord)	C-351
	Location F: Hanscom Drive, north of Old Bedford Road (Lincoln)	C-387
C-4	2012 Vehicle Occupancy Survey	C-423
C-5	SYNCHRO Level of Service Analysis:2012	C-426
	<u>MORNING PEAK HOURS:</u>	
	#5 Hanscom Drive & Old Bedford Road, Lincoln	C-427
	#6 Hanscom Drive & Route 2A, Lincoln	C-429
	#10 Old Bedford Road & Virginia Road, Concord	C-431
	<u>AFTERNOON PEAK HOURS:</u>	
	#5 Hanscom Drive & Old Bedford Road, Lincoln	C-433
	#6 Hanscom Drive & Route 2A, Lincoln	C-435
	#10 Old Bedford Road & Virginia Road, Concord	C-437
C-6	SYNCHRO LOS Analysis: 2020 No Build	C-439
	<u>MORNING PEAK HOURS:</u>	
	#5 Hanscom Drive & Old Bedford Road, Lincoln	C-440
	#6 Hanscom Drive & Route 2A, Lincoln	C-442
	#10 Old Bedford Road & Virginia Road, Concord	C-444
	<u>AFTERNOON PEAK HOURS:</u>	
	#5 Hanscom Drive & Old Bedford Road, Lincoln	C-446
	#6 Hanscom Drive & Route 2A, Lincoln	C-448
	#10 Old Bedford Road & Virginia Road, Concord	C-450
C-7	SYNCHRO LOS Analysis: 2020 Build	C-452
	<u>MORNING PEAK HOURS:</u>	
	#5 Hanscom Drive & Old Bedford Road, Lincoln	C-453
	#6 Hanscom Drive & Route 2A, Lincoln	C-455
	#10 Old Bedford Road & Virginia Road, Concord	C-457
	<u>AFTERNOON PEAK HOURS:</u>	
	#5 Hanscom Drive & Old Bedford Road, Lincoln	C-459
	#6 Hanscom Drive & Route 2A, Lincoln	C-461
	#10 Old Bedford Road & Virginia Road, Concord	C-463

C-8	SYNCHRO LOS Analysis: 2030 No Build	C-465
	<u>MORNING PEAK HOURS:</u>	
	#2 Massachusetts Avenue & Route 2A, Lexington	C-466
	#3 Old Massachusetts Avenue & Route 2A, Lexington	C-469
	#4 Airport Road & Route 2A, Lexington	C-471
	#5 Hanscom Drive & Old Bedford Road, Lincoln	C-473
	#6 Hanscom Drive & Route 2A, Lincoln	C-475
	#10 Old Bedford Road & Virginia Road, Concord	C-477
	<u>AFTERNOON PEAK HOURS:</u>	
	#2 Massachusetts Avenue & Route 2A, Lexington	C-479
	#3 Old Massachusetts Avenue & Route 2A, Lexington	C-482
	#4 Airport Road & Route 2A, Lexington	C-484
	#5 Hanscom Drive & Old Bedford Road, Lincoln	C-486
	#6 Hanscom Drive & Route 2A, Lincoln	C-488
	#10 Old Bedford Road & Virginia Road, Concord	C-490
C-9	SYNCHRO LOS Analysis: 2030 Build	C-492
	<u>MORNING PEAK HOURS:</u>	
	#2 Massachusetts Avenue & Route 2A, Lexington	C-493
	#3 Old Massachusetts Avenue & Route 2A, Lexington	C-496
	#4 Airport Road & Route 2A, Lexington	C-498
	#5 Hanscom Drive & Old Bedford Road, Lincoln	C-500
	#6 Hanscom Drive & Route 2A, Lincoln	C-502
	#10 Old Bedford Road & Virginia Road, Concord	C-504
	<u>AFTERNOON PEAK HOURS:</u>	
	#2 Massachusetts Avenue & Route 2A, Lexington	C-506
	#3 Old Massachusetts Avenue & Route 2A, Lexington	C-509
	#4 Airport Road & Route 2A, Lexington	C-511
	#5 Hanscom Drive & Old Bedford Road, Lincoln	C-513
	#6 Hanscom Drive & Route 2A, Lincoln	C-515
	#10 Old Bedford Road & Virginia Road, Concord	C-517
C-10	SYNCHRO Peak Roundabout Analysis: 2030 Build	C-519
	<u>MORNING PEAK HOURS:</u>	
	#5 Hanscom Drive & Old Bedford Road, Lincoln	C-520
	<u>AFTERNOON PEAK HOURS:</u>	
	#5 Hanscom Drive & Old Bedford Road, Lincoln	C-521
C-11	2006-2010 MassDOT Crash Worksheets	C-522
	#5 Hanscom Drive & Old Bedford Road, Lincoln	C-523
	#6 Hanscom Drive & Route 2A, Lincoln	C-524
	#10 Old Bedford Road & Virginia Road, Concord	C-525
C-11	Trip Generation Estimates	C-526

Appendix C-1

2013 Hanscom Field Travel Questionnaire

2013 Hanscom Field Travel Questionnaire

Page One

2013 Hanscom Field Travel Questionnaire

To all commuters to Hanscom Field (employees and students):

Thank you for taking the time to give us your feedback.

Why have you been given this questionnaire:

Massport is conducting a commute survey of all people working or attending classes at Hanscom Field. These surveys provide information to improve travel to and from the airport.

How to return the completed questionnaires:

Please complete this survey by July 26, 2013.

Should you have any questions regarding the survey:

Please contact Tom Ennis at 617.568.3546 or ennis@massport.com

We appreciate your participation and cooperation in completing the survey!

Page 2

1. Where do you currently reside?

Street address or nearest intersection

City

State

ZIP

2. If your trip to the field does not begin at your residence, from where does it originate?

Street address or nearest intersection

City

State

ZIP

3. Are you a student or employee at Hanscom Field?

☐ Student

☐ Employee

What company at Hanscom is your main employer?

What school at Hanscom do you attend?

4. Which of the following best describes your job/student status?

☐ Permanent full-time

☐ Permanent part-time

☐ Temporary full-time

☐ Temporary part-time

5. What time do you typically arrive and depart Hanscom?

	Arrival Time	Departure Time
Monday	<input type="text"/>	<input type="text"/>
Tuesday	<input type="text"/>	<input type="text"/>

Wednesday	<input type="text"/>	<input type="text"/>
Thursday	<input type="text"/>	<input type="text"/>
Friday	<input type="text"/>	<input type="text"/>
Saturday	<input type="text"/>	<input type="text"/>
Sunday	<input type="text"/>	<input type="text"/>

6. How often do you vary your work or school hours by more than 30 minutes?

- ☐ 1-2 days per week
- ☐ 3+ days per week
- ☐ 1-2 days per month
- ☐ 3+ days per month
- ☐ Other *

7. How do you get to Hanscom on most days? What type of transportation do you take?

- ☐ Drive alone
- ☐ Dropped off by someone who does not work at Hanscom
- ☐ Car pool with other Hanscom employees or students
- ☐ Public Transportation
- ☐ Walk
- ☐ Bicycle
- ☐ Other *

Which of the following do you use? (check all that apply)

- ☐ MBTA 76 Bus
- ☐ LexExpress

☐ MBTA Commuter Rail

☐ Other *

How many people are usually in the car (including yourself)?

Do you have a valid Driver's license?

☐ Yes

☐ No

Do you have a working vehicle to use?

☐ Yes

☐ No

☐ Sometimes

Page 3

8. If you usually drive alone or carpool to Hanscom, where do you usually park?

☐ In your employer's/school's parking area near your place of work/school

☐ In the Civil Terminal parking area

☐ On the military base

☐ Elsewhere on airport *

☐ Elsewhere off airport *

9. On average, how often do you leave Hanscom during the day:

For work/school-related reasons

-- Please Select --
Frequently
Sometimes
Rarely

For personal reasons

-- Please Select --
Frequently
Sometimes
Rarely

Do you use your personal vehicle for these trips?

- ☐ Yes
- ☐ No, I use a work vehicle
- ☐ No (other) *

10. How long does it take you to travel to Hanscom on a typical day (minutes one-way)?

11. How much do YOU pay for your commute?

	Per day	Per month
Parking	<input type="text"/>	<input type="text"/>
Tolls	<input type="text"/>	<input type="text"/>
Bus, train fares or passes	<input type="text"/>	<input type="text"/>

12. If you sometimes get to work a different way, how do you make the trip? (check all that apply)

- ☐ Drive alone
- ☐ Dropped off by someone who does not work at Hanscom
- ☐ Car pool with other Hanscom employees or students
- ☐ Public Transportation
- ☐ Walk

☐ Bicycle

☐ Other

*

Which of the following do you use? (check all that apply)

☐ MBTA 76 Bus

☐ LexExpress

☐ MBTA Commuter Rail

☐ Other

*

13. If you drive alone to Hanscom, which of the following describes your reasons? (rank all that apply)

Drag items from the left-hand list into the right-hand list to order them.

Convenience

Privacy

Quickest way to
work

Irregular work
schedule

Need car for
personal
reasons

Other modes not
as safe

Other modes
cost too much

Transit
schedules do
not work for me

Need car for
work-related
trips

Don't like taking
the bus

Need car for
daycare

Need car for
emergencies

Not aware of
other options

Other

Page 4

14. Please rank the TOP THREE alternatives that you would consider for traveling to Hanscom Field:

Drag items from the left-hand list into the right-hand list to order them.

Transit

Bicycle

Walk

Carpool (2+
passengers)

Vanpool (6+
passengers)

Other

15. Would you be willing to share a ride (i.e. carpool) for part or all of the week to and from work with others who might live near you if the schedule was accommodating?

- ☐ Yes
- ☐ No
- ☐ Already do

16. Would you be willing to change to RIDESHARING (i.e. carpooling) if the following incentives or

services were in place? (rank all that apply)

Drag items from the left-hand list into the right-hand list to order them.

Free guaranteed ride home

Preferential parking for carpools

Finding someone to carpool with

Company car available if necessary

Financial incentive

Shuttle bus from park and ride

Other

17. If you currently drive alone, would you be willing to change to using TRANSIT if the following incentives or services were in place? (rank all that apply)

Drag items from the left-hand list into the right-hand list to order them.

Subsidy for bus passes

On-site information on routes and times

Better transit routes

Guaranteed ride home

Company car available if necessary

Other

18. What prevents you from using public bus transportation service? (check all that apply)

- ☐ No bus near home
- ☐ Bus schedule does not work for me
- ☐ The bus is not safe
- ☐ The cost savings is not enough
- ☐ There is no direct route from my home
- ☐ Other *

Page 5

19. Would you be willing to change to riding a BICYCLE if the following incentives or services were in place? (rank all that apply)

Drag items from the left-hand list into the right-hand list to order them.

Reward
programs

Lockers and
showers

Secured/covered
bike parking

Bad weather
plans

Company car
available if
necessary

Bike path from
home to
Hanscom Field

Other

20. What prevents you from riding a bicycle to Hanscom? (check all that apply)

- ☐ No safe route from my home
- ☐ No bicycle parking at Hanscom
- ☐ Too far to bike from home
- ☐ I do not own a bicycle
- ☐ Unpredictable weather
- ☐ Mobility impairment

☐ Other *

21. Would you be willing to use a combination of public transportation and bicycling/walking to get to Hanscom?

- ☐ Yes
- ☐ No

22. Would you be willing to change to WALKING if the following incentives or services were in place? (rank all that apply)

Drag items from the left-hand list into the right-hand list to order them.

Reward programs

Lockers and showers

Bad weather plans

Company car available if necessary

Sidewalks from home to Hanscom field

Other

23. What prevents you from walking to Hanscom? (check all that apply)

☐ No safe route from my home

☐ Too far to walk from home

☐ Unpredictable weather

☐ Mobility impairment

☐ Other *

24. What would most motivate you to choose to shared a ride, take transit, walk or bike? (rank all that apply)

Drag items from the left-hand list into the right-hand list to order them.

The incentives
offered

Helping the
environment

Reducing traffic
and congestion

Health benefits
of walking/biking

Social
interactions of
car pools

Reduced cost of
commuting

Other

Page 6

25. Would you like to learn more about programs and incentives to encourage alternative commuting choices?

☐ Yes

☐ No

26. Are you:

☐ Male

☐ Female

27. What is your age?

☐ Under 18

☐ 18 to 24

☐ 25 to 34

☐ 35 to 44

☐ 45 to 54

☐ 55 or over

28. Do you have any other thoughts or comments on transportation to/from Hanscom Field?

Thank You!

Thank you for taking our survey. Your response is very important to us.



Summary Report - Sep 4, 2013 (Q5)

Survey: 2013 Hanscom Field Travel Questionnaire

1. Where do you currently reside?:Street address or nearest intersection

Count	Response
1	10 Durant Aveune
1	10 Old Beach Road
1	100 Farm Road
1	117 East Bare Hill Road
1	12 Trotting Horse
1	13 Liberty Rosd
1	15 hillside ter.
1	150 hanscom Dr
1	17 Ernies Drive
1	2 Coral St.
1	20 Archdale Rd
1	22 Blackburnian Rd
1	28 Aborn Place
1	29 Denny Road
1	291 granite st
1	3315 Stearns ill rd
1	35 Meriam Street
1	378 Chatham St
1	39 Whitney Farms RD
1	4 Nehemiah rd
1	401 Sandy Valley Rd
1	43 12th Street
1	5 Partridge Ln
1	52 violetwood cir
1	65 Brainerd Rd
1	7 Oak Knoll Dr
1	76 coburn hill road
1	9 Diane La
1	90 Jackson Drive

1	909 Pleasant St
1	99 B Wilmington Rd
1	99 Mill Pond Rd
1	Avon St
1	BROADWAY
1	Bayberry St.
1	Carlton St
1	Depot St
1	Faxon St.
1	Hanscom Drive
1	Mill Brook High st
1	New Road
1	Orris Street at Orris Place
1	Porter Ave
1	Railroad ave
1	South Road
1	WINN STREET
1	Washington St.
1	Westford Rd
1	mount hope
1	munroe ave

1. Where do you currently reside?:City

Count	Response
1	Allston
1	Arlington
1	BURLINGTON
3	Bedford
1	Beford
1	Brockton
1	Brookline
2	Burlington
1	CONCORD
1	Canton
1	Carlisle
1	Chestnut Hill

1	Derry
1	Duxbury
1	Exeter
1	Harvard
4	Lexington
1	Lincoln
1	Littleton
1	Lowell
3	Lynn
1	Marshfield
1	Maynard
1	Melrose
1	Middleton
1	Nashua
1	Newmarket
1	Newton
1	North Yarmouth
1	Pepperell
1	Raynham
1	Roslindale
1	SOMERVILLE
1	SUdbury
1	Salem
1	Sandown
1	Sherborn
1	Shirley
1	Wakefield
1	Waltham
1	West Roxbury
1	Westwood
1	Weymouth
1	Woburn
1	concord
1	lowell
1	malden
1	marlborough
1	quincy
1	walpole

1 woburn

1. Where do you currently reside?:State

Count	Response
35	MA
2	MA
1	MA.
1	ME
6	Ma
1	Massachusetts
4	NH
1	RI
6	ma
1	mass
2	nh

1. Where do you currently reside?:ZIP

Count	Response
1	01451
1	01460
1	01463
1	01464
4	01730
1	01741
2	01742
1	01752
1	01754
1	01770
1	01773
1	01776
2	01801
3	01803
1	01850
1	01854

1	01880
3	01902
1	01949
1	02021
1	02050
1	02081
1	02090
1	02131
1	02132
1	02134
1	02145
1	02148
1	02169
1	02176
1	02189
1	02302
1	02332
1	02420
2	02421
1	02446
1	02458
1	02467
1	02474
1	02767
1	02822
1	03038
1	03062
1	03079
1	03857
1	03873
1	04097
1	MA 02421

2. If your trip to the field does not begin at your residence, from where does it originate?:Street address or nearest intersection

Count Response

1	1 Harborside Drive
1	150 Hanscom Drive
1	Alewife Station Busway
1	NA
1	South Road
1	Wonderland

2. If your trip to the field does not begin at your residence, from where does it originate?:City

Count	Response
2	Bedford
1	Boston
1	Brockton
1	LEXINGTON
1	Lexington
1	medford
1	revere

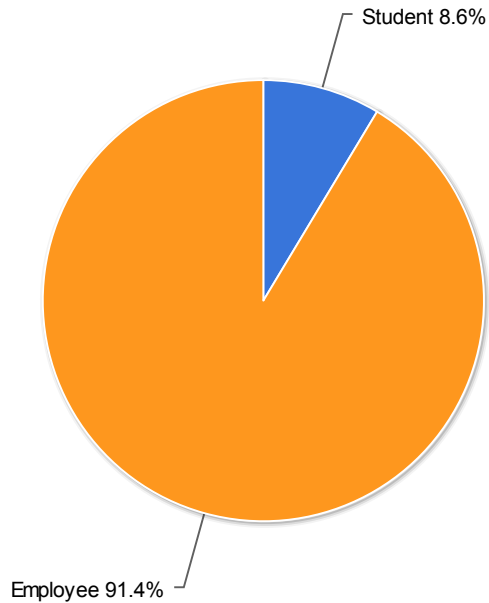
2. If your trip to the field does not begin at your residence, from where does it originate?:State

Count	Response
6	MA
1	MA
1	ma

2. If your trip to the field does not begin at your residence, from where does it originate?:ZIP

Count	Response
2	01730
1	02128
1	02135
1	02302

3. Are you a student or employee at Hanscom Field?



3. Are you a student or employee at Hanscom Field?

Value	Count	Percent %
Student	5	8.6%
Employee	53	91.4%

Statistics

Total Responses	58
-----------------	----

What company at Hanscom is your main employer?

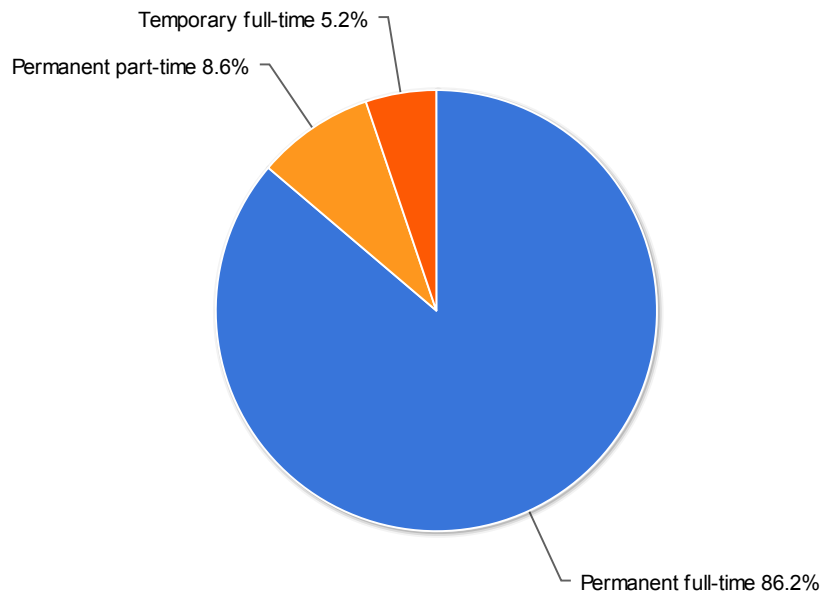
Count	Response
1	AirShares Elite & MedFlight
1	BSC/Stream Ent
1	Boston Aviation
2	Boston JetSearch, Inc.
1	Boston MedFlight
1	Boston Medflight
3	Boston Scientific
1	Cordinates Operations LLC
1	East Coast Aero Club
1	FAA
3	Jet Aviation
1	Jet Aviation (Tenant)
2	Linear Air

1	Massachusetts Air And Space Museum
5	Massport
1	Midon
1	NAA
1	NATIONAL AVIATION ACADEMY
7	National Aviation Academy
2	Raytheon
1	Raytheon Company
4	Rectrix
3	Rectrix Aviation
3	Signature Flight Support
1	Stream Enterprise
1	THL Partners
1	THL Partners, LLC
1	The National Aviation Academy
1	national aviation accademy

What school at Hanscom do you attend?

Count	Response
4	National Aviation Academy
1	naa

4. Which of the following best describes your job/student status?



4. Which of the following best describes your job/student status?

Value	Count	Percent %
Permanent full-time	50	86.2%
Permanent part-time	5	8.6%
Temporary full-time	3	5.2%
Temporary part-time	0	0.0%

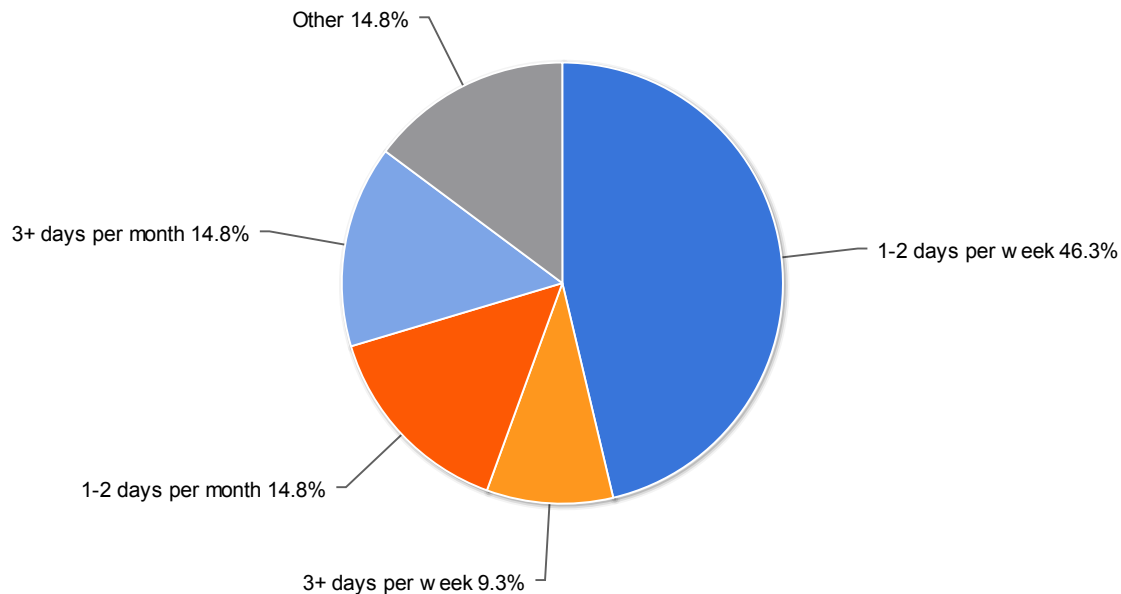
Statistics

Total Responses	58
-----------------	----

5. What time do you typically arrive and depart Hanscom?

	Arrival Time	Departure Time	Responses
Monday	100.0% 54	98.1% 53	54
Tuesday	100.0% 52	98.1% 51	52
Wednesday	100.0% 52	98.1% 51	52
Thursday	100.0% 51	98.0% 50	51
Friday	100.0% 51	100.0% 51	51
Saturday	100.0% 13	100.0% 13	13
Sunday	100.0% 10	90.0% 9	10

6. How often do you vary your work or school hours by more than 30 minutes?



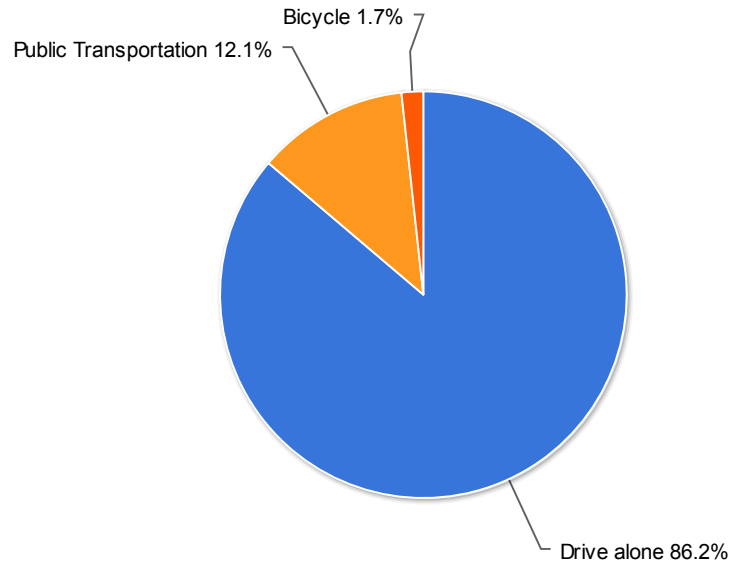
6. How often do you vary your work or school hours by more than 30 minutes?

Value	Count	Percent %
1-2 days per week	25	46.3%
3+ days per week	5	9.3%
1-2 days per month	8	14.8%
3+ days per month	8	14.8%
Other	8	14.8%

Statistics	
Total Responses	54
Sum	72.0
Avg.	1.6
StdDev	0.9
Max	3.0

Open-Text Response Breakdown for "Other"	Count
16 out of 16 per/mo	1
Depends if I need to flex	1
Retired	1
Varies all the time	1
never	2
none	1
I work at Hanscom approximately 8-10 per month arriving and departing at various times during the day and traveling either from my home or LOC	1

7. How do you get to Hanscom on most days? What type of transportation do you take?



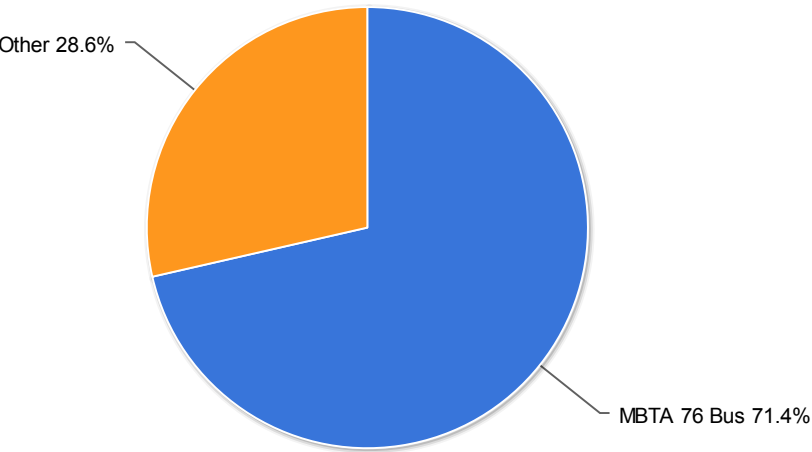
7. How do you get to Hanscom on most days? What type of transportation do you take?

Value	Count	Percent %
Drive alone	50	86.2%
Dropped off by someone who does not work at Hanscom	0	0.0%
Car pool with other Hanscom employees or students	0	0.0%
Public Transportation	7	12.1%
Walk	0	0.0%
Bicycle	1	1.7%
Other	0	0.0%

Statistics

Total Responses	58
-----------------	----

Which of the following do you use? (check all that apply)



Which of the following do you use? (check all that apply)

Value	Count	Percent %
MBTA 76 Bus	5	71.4%
LexExpress	0	0.0%
MBTA Commuter Rail	0	0.0%
Other	2	28.6%

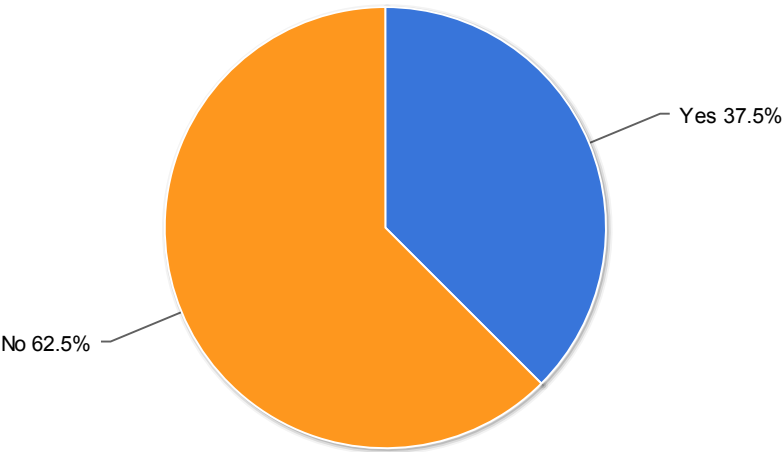
Statistics	
Total Responses	7

Open-Text Response Breakdown for "Other"	Count
MBTA Green and Red line	1
Subway(Blue,Green or Orange, Red Lines)	1

How many people are usually in the car (including yourself)?

Count	Response
-------	----------

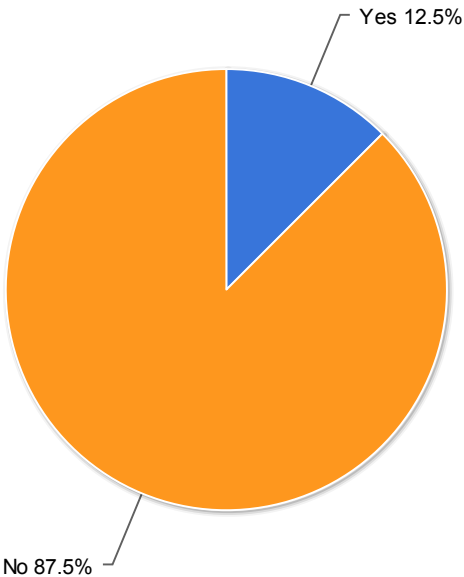
Do you have a valid Driver's license?



Do you have a valid Driver's license?

Value	Count	Percent %	Statistics	
Yes	3	37.5%	Total Responses	8
No	5	62.5%		

Do you have a working vehicle to use?



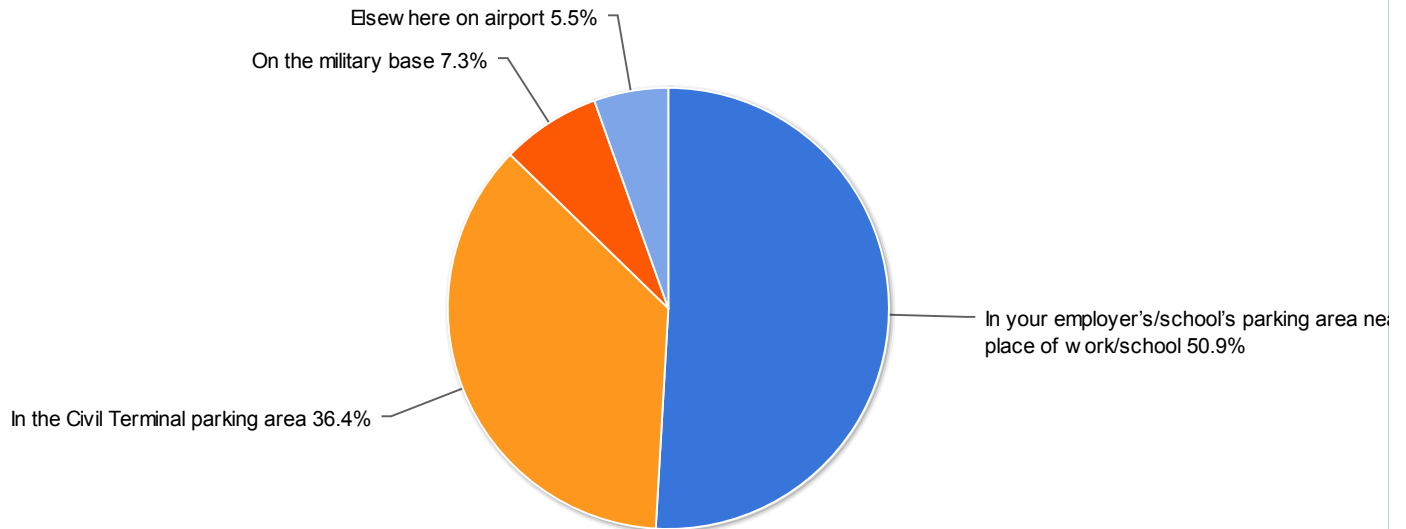
Do you have a working vehicle to use?

Value	Count	Percent %	Statistics	

Yes	1	12.5%
No	7	87.5%
Sometimes	0	0.0%

Total Responses	8
-----------------	---

8. If you usually drive alone or carpool to Hanscom, where do you usually park?



8. If you usually drive alone or carpool to Hanscom, where do you usually park?

Value	Count	Percent %
In your employer's/school's parking area near your place of work/school	28	50.9%
In the Civil Terminal parking area	20	36.4%
On the military base	4	7.3%
Elsewhere on airport	3	5.5%
Elsewhere off airport	0	0.0%

Statistics	
Total Responses	55

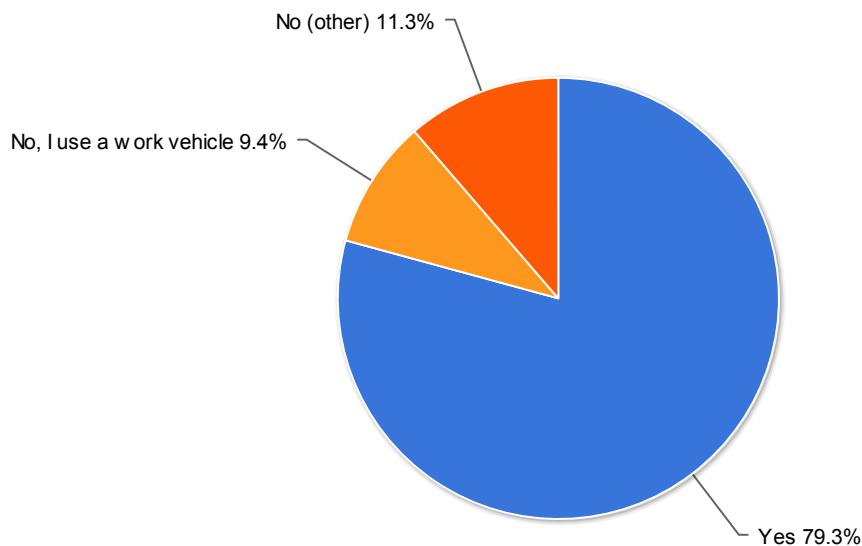
Open-Text Response Breakdown for "Elsewhere on airport"	Count
FAA CONTROL TWR	1
Outter Parking lot	1
i dont drive	1

9. On average, how often do you leave Hanscom during the day:

	Frequently	Sometimes	Rarely	Never	Responses
For work/school-related reasons	12.7%	27.3%	45.5%	14.5%	55

	7	15	25	8	
For personal reasons	7.1%	16.1%	57.1%	19.6%	56
	4	9	32	11	

Do you use your personal vehicle for these trips?



Do you use your personal vehicle for these trips?

Value	Count	Percent %
Yes	42	79.3%
No, I use a work vehicle	5	9.4%
No (other)	6	11.3%

Statistics

Total Responses	53
-----------------	----

Open-Text Response Breakdown for "No (other)"

	Count
Bus, Trains	1
MBTA bus 76	1
Mbta 76	1
bus	1
dont have a car	1
work car for work, personal car for personal	1

10. How long does it take you to travel to Hanscom on a typical day (minutes one-way)?

Count	Response

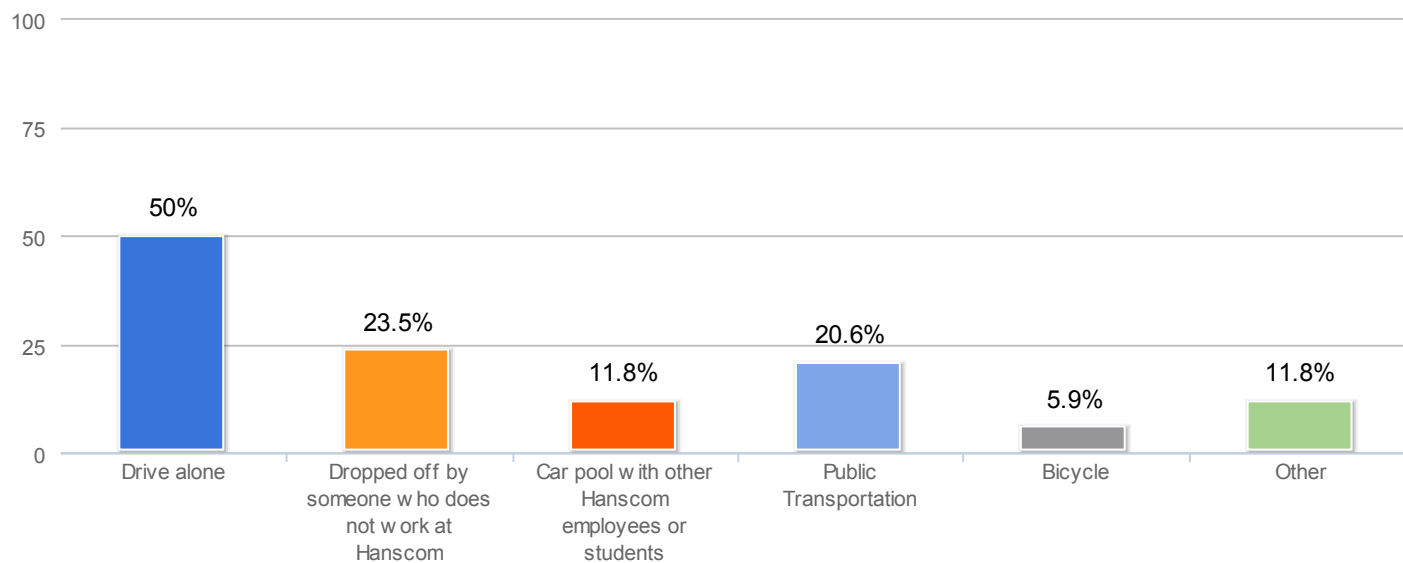
1	1 -2 hours
1	1 hour
1	1.5 hours
1	10 minutes
4	120
5	15
2	15 minutes
1	2 hours
1	2 hrs.
1	20
3	20 minutes
1	20 to 30 mins
1	20-45
1	25
1	25 MINUTES
1	25 minutes
1	25,-35 with traffic on rte 2.
1	2hr
2	30
1	30 MINUTES
1	30 minutes
1	35-45 minutes
3	40
1	40 min.
2	40 minutes
6	45
1	45 min
1	45 minutes
1	45-60 minutes
1	45min
1	55
1	6
1	60
1	60 minutes
1	80 minutes
3	90
1	:30
1	:35
1	half hour

1 hour to hour and half

11. How much do YOU pay for your commute?

	Per day	Per month	Responses
Parking	96.4% 27	78.6% 22	28
Tolls	96.6% 28	82.8% 24	29
Bus, train fares or passes	84.8% 28	84.8% 28	33

12. If you sometimes get to work a different way, how do you make the trip? (check all that apply)



12. If you sometimes get to work a different way, how do you make the trip? (check all that apply)

Value	Count	Percent %
Drive alone	17	50.0%
Dropped off by someone who does not work at Hanscom	8	23.5%
Car pool with other Hanscom employees or students	4	11.8%
Public Transportation	7	20.6%
Walk	0	0.0%
Bicycle	2	5.9%

Statistics

Total Responses	34
-----------------	----

Other

4

11.8%

Open-Text Response Breakdown for "Other"

Count

Left Blank

63

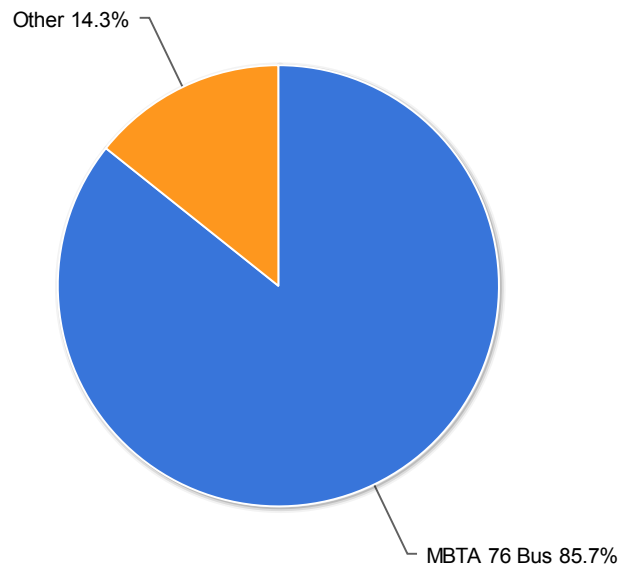
Retired

1

motorcycle

2

Which of the following do you use? (check all that apply)



Which of the following do you use? (check all that apply)

Value	Count	Percent %
MBTA 76 Bus	6	85.7%
LexExpress	0	0.0%
MBTA Commuter Rail	0	0.0%
Other	1	14.3%

Statistics

Total Responses

7

Open-Text Response Breakdown for "Other"

Count

Bus, Subway

1

**13. If you drive alone to Hanscom, which of the following describes your reasons?
(rank all that apply)**

Item

Total Score¹

Overall Rank

Quickest way to work	539	1
Convenience	520	2
Irregular work schedule	322	3
Need car for personal reasons	302	4
Transit schedules do not work for me	266	5
Need car for work-related trips	185	6
Privacy	178	7
Need car for emergencies	125	8
Not aware of other options	91	9
Don't like taking the bus	68	10
Need car for daycare	42	11
Other modes not as safe	42	12
Other	40	13
Other modes cost too much	18	14

Total Respondents: 54

¹ Score is a weighted calculation. Items ranked first are valued higher than the following ranks, the score is the sum of all weighted rank counts.

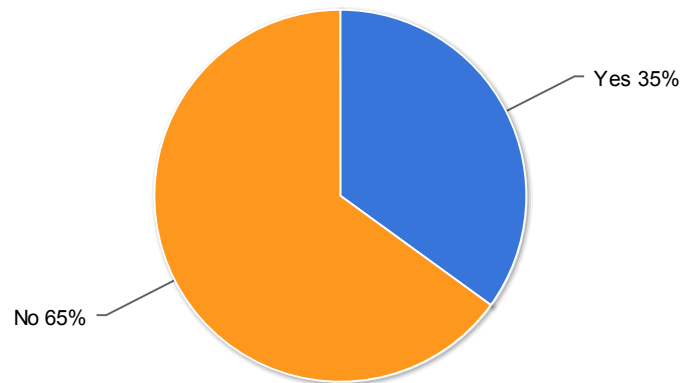
14. Please rank the TOP THREE alternatives that you would consider for traveling to Hanscom Field:

Item	Total Score ¹	Overall Rank
Transit	149	1
Carpool (2+ passengers)	141	2
Other	78	3
Vanpool (6+ passengers)	60	4
Bicycle	45	5
Walk	23	6

Total Respondents: 42

¹ Score is a weighted calculation. Items ranked first are valued higher than the following ranks, the score is the sum of all weighted rank counts.

15. Would you be willing to share a ride (i.e. carpool) for part or all of the week to and from work with others who might live near you if the schedule was accommodating?



15. Would you be willing to share a ride (i.e. carpool) for part or all of the week to and from work with others who might live near you if the schedule was accommodating?

Value	Count	Percent %
Yes	21	35.0%
No	39	65.0%
Already do	0	0.0%

Statistics

Total Responses	60
-----------------	----

16. Would you be willing to change to RIDESHARING (i.e. carpooling) if the following incentives or services were in place? (rank all that apply)

Item	Total Score ¹	Overall Rank
Financial incentive	57	1
Finding someone to carpool with	50	2
Free guaranteed ride home	45	3
Company car available if necessary	31	4
Other	25	5
Shuttle bus from park and ride	22	6
Preferential parking for carpools	2	7

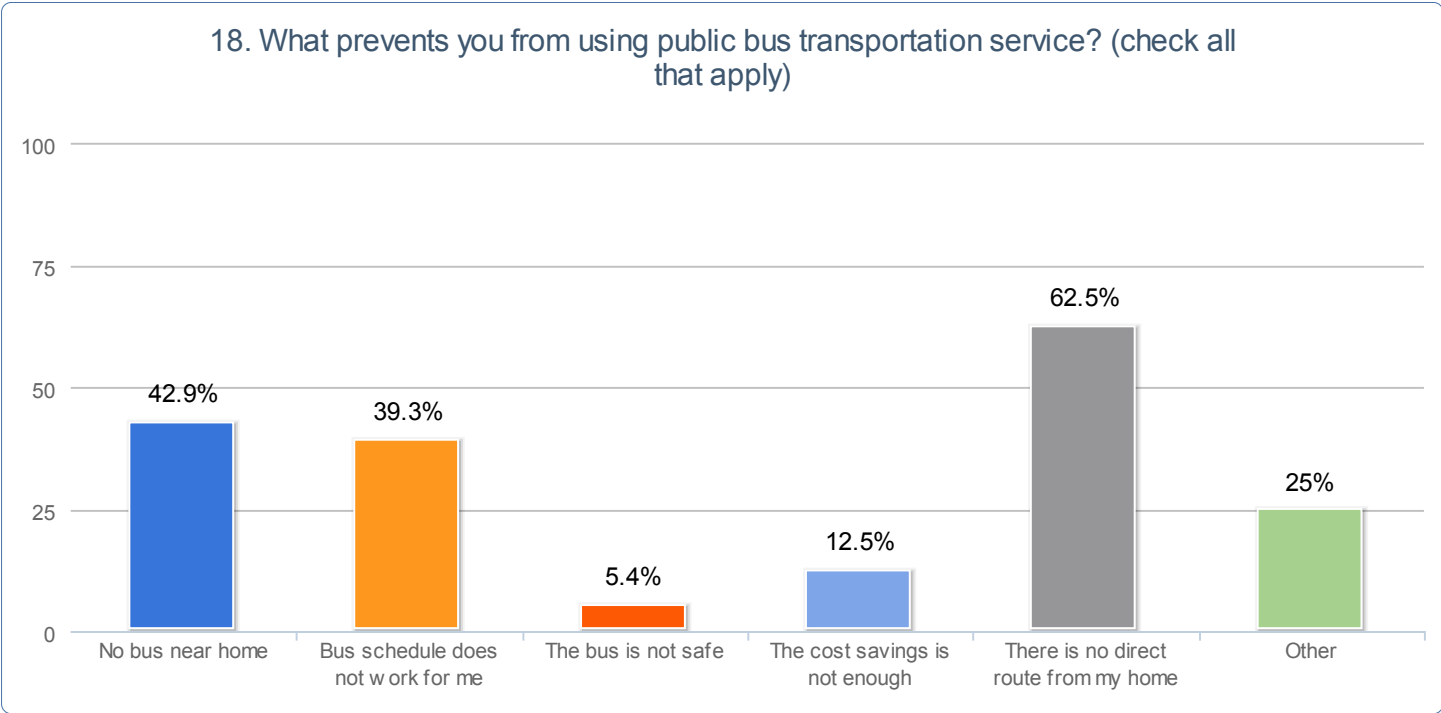
Total Respondents: 32

¹ Score is a weighted calculation. Items ranked first are valued higher than the following ranks, the score is the sum of all weighted rank counts.

17. If you currently drive alone, would you be willing to change to using TRANSIT if

the following incentives or services were in place? (rank all that apply)

Item	Total Score ¹	Overall Rank
Better transit routes	65	1
Guaranteed ride home	45	2
Company car available if necessary	41	3
Other	27	4
Subsidy for bus passes	26	5
On-site information on routes and times	23	6
Total Respondents: 27		
¹ Score is a weighted calculation. Items ranked first are valued higher than the following ranks, the score is the sum of all weighted rank counts.		



18. What prevents you from using public bus transportation service? (check all that apply)

Value	Count	Percent %
No bus near home	24	42.9%
Bus schedule does not work for me	22	39.3%
The bus is not safe	3	5.4%
The cost savings is not enough	7	12.5%
There is no direct route from my home	35	62.5%
Other	14	25.0%

Statistics	
Total Responses	56

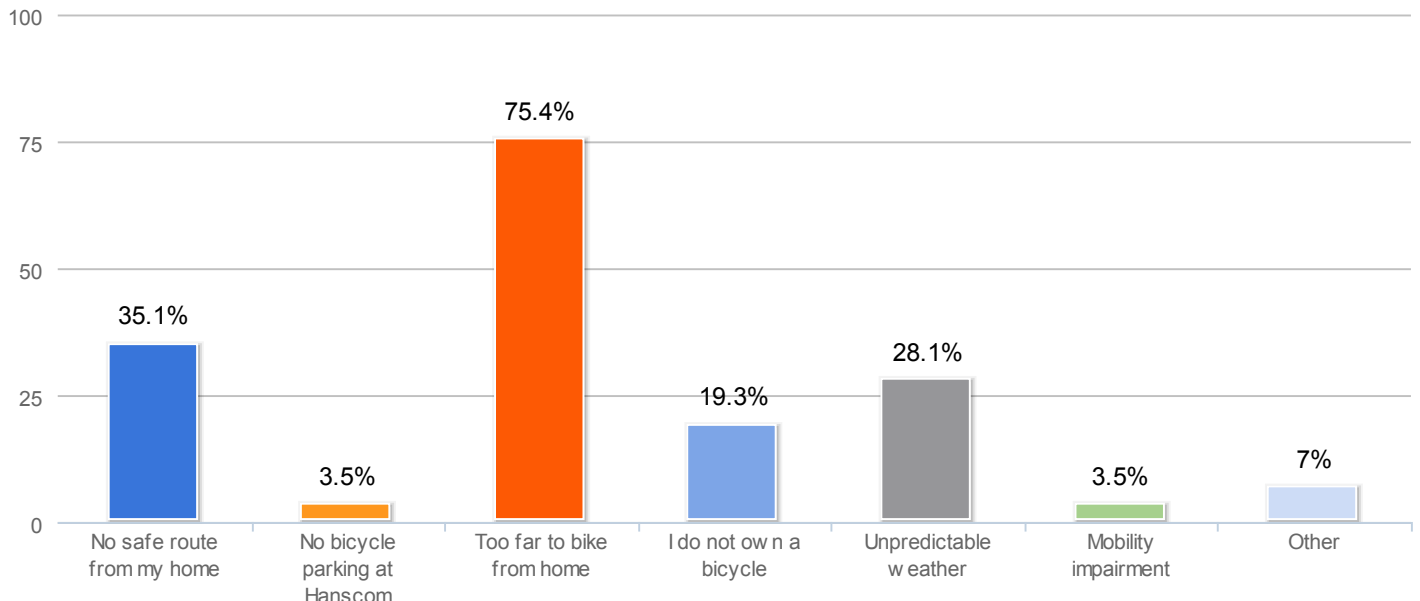
Open-Text Response Breakdown for "Other"	Count
--	-------

<i>Left Blank</i>	52
Already take bus	1
Irregular schedule	1
Irregular schedule	1
Manager	1
Not convenient	1
There is no route, direct or indirect, from my home.	1
Would cost more, since I'd keep my car and related costs	1
i already take the bus	1
i need to travel to various sites during the day and need a vehicle	1
need car at times	1
need car for daycare pickup	1
no need	1
nothing keep the 76	1
unpredictable work schedules	1

19. Would you be willing to change to riding a BICYCLE if the following incentives or services were in place? (rank all that apply)

Item	Total Score ¹	Overall Rank
Lockers and showers	39	1
Bike path from home to Hanscom Field	34	2
Other	28	3
Secured/covered bike parking	20	4
Reward programs	20	5
Company car available if necessary	13	6
Bad weather plans	12	7
Total Respondents: 20		
¹ Score is a weighted calculation. Items ranked first are valued higher than the following ranks, the score is the sum of all weighted rank counts.		

20. What prevents you from riding a bicycle to Hanscom? (check all that apply)



20. What prevents you from riding a bicycle to Hanscom? (check all that apply)

Value	Count	Percent %
No safe route from my home	20	35.1%
No bicycle parking at Hanscom	2	3.5%
Too far to bike from home	43	75.4%
I do not own a bicycle	11	19.3%
Unpredictable weather	16	28.1%
Mobility impairment	2	3.5%
Other	4	7.0%

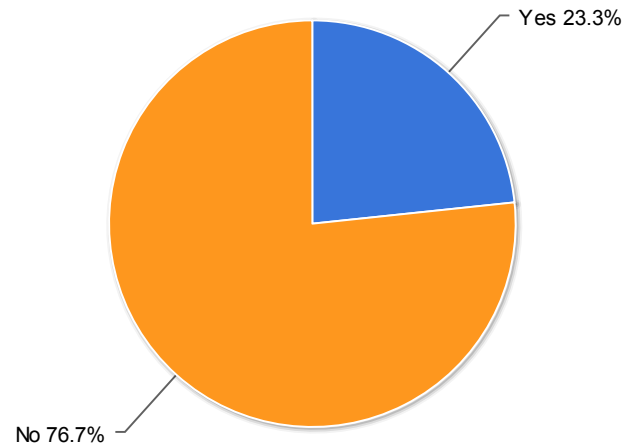
Statistics

Total Responses	57
-----------------	----

Open-Text Response Breakdown for "Other"

	Count
<i>Left Blank</i>	62
Costs me an hour of work time in my day, and I arrive uncomfortably sweaty	1
Not as convenient	1
Unpredictable schedule/need for car	1
age	1

21. Would you be willing to use a combination or public transportation and bicycling/walking to get to Hanscom?



21. Would you be willing to use a combination or public transportation and bicycling/walking to get to Hanscom?

Value	Count	Percent %
Yes	14	23.3%
No	46	76.7%

Statistics

Total Responses	60
-----------------	----

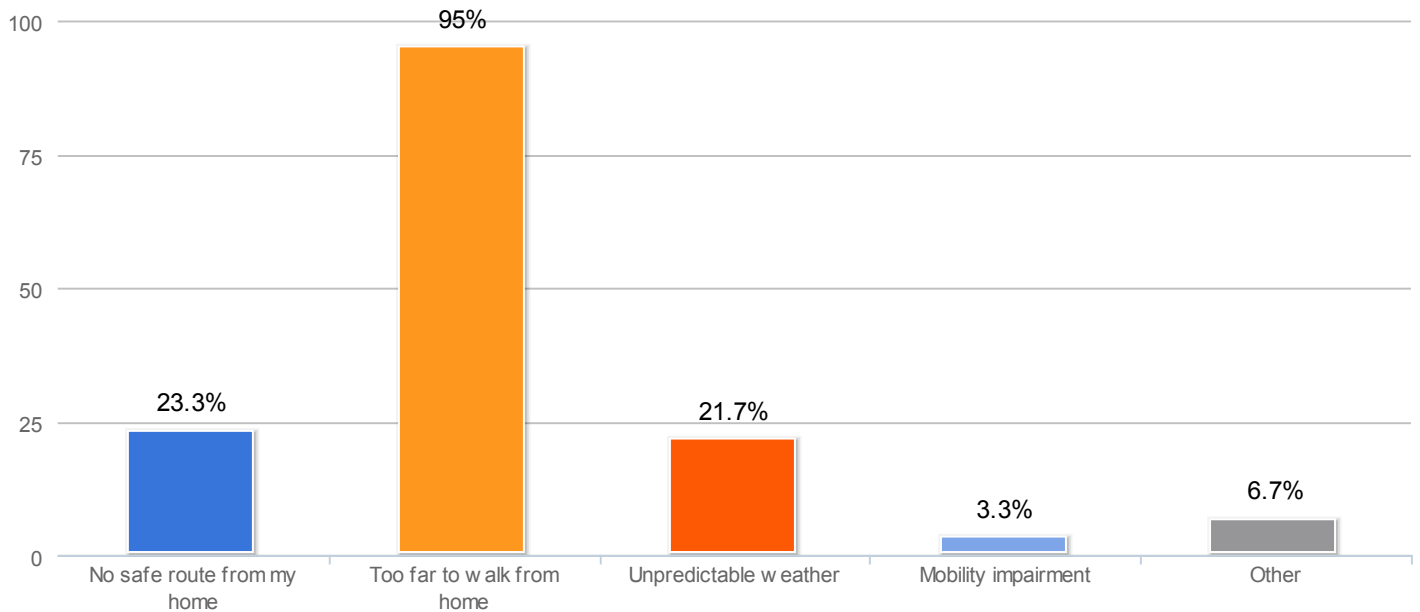
22. Would you be willing to change to WALKING if the following incentives or services were in place? (rank all that apply)

Item	Total Score ¹	Overall Rank
Other	16	1
Reward programs	11	2
Sidewalks from home to Hanscom field	8	3
Bad weather plans	8	4
Company car available if necessary	7	5
Lockers and showers	3	6

Total Respondents: 10

¹ Score is a weighted calculation. Items ranked first are valued higher than the following ranks, the score is the sum of all weighted rank counts.

23. What prevents you from walking to Hanscom? (check all that apply)



23. What prevents you from walking to Hanscom? (check all that apply)

Value	Count	Percent %
No safe route from my home	14	23.3%
Too far to walk from home	57	95.0%
Unpredictable weather	13	21.7%
Mobility impairment	2	3.3%
Other	4	6.7%

Statistics

Total Responses	60
-----------------	----

Open-Text Response Breakdown for "Other"

	Count
<i>Left Blank</i>	62
I am 73 years old	1
Takes too long	1
baggage	1
need car for daycare pickup	1

24. What would most motivate you to choose to shared a ride, take transit, walk or bike? (rank all that apply)

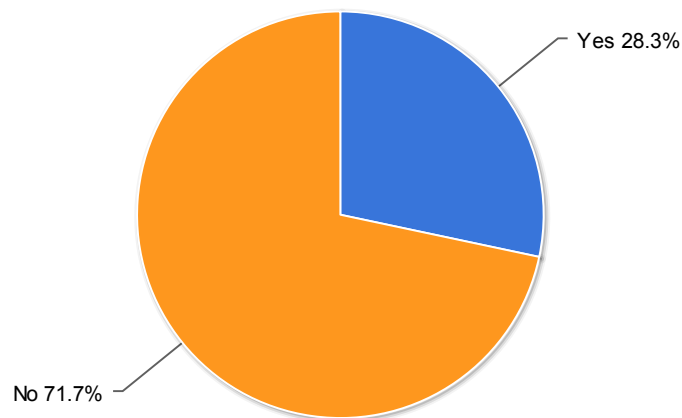
Item	Total Score ¹	Overall Rank
Reduced cost of commuting	85	1
The incentives offered	67	2
Reducing traffic and congestion	37	3
Health benefits of walking/biking	33	4

Helping the environment	27	5
Other	14	6
Social interactions of car pools	13	7

Total Respondents: 34

¹ Score is a weighted calculation. Items ranked first are valued higher than the following ranks, the score is the sum of all weighted rank counts.

25. Would you like to learn more about programs and incentives to encourage alternative commuting choices?

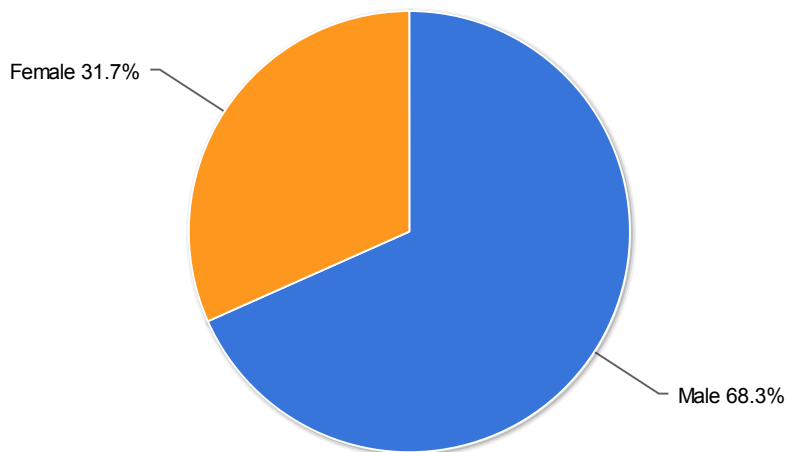


25. Would you like to learn more about programs and incentives to encourage alternative commuting choices?

Value	Count	Percent %
Yes	17	28.3%
No	43	71.7%

Statistics	
Total Responses	60

26. Are you:



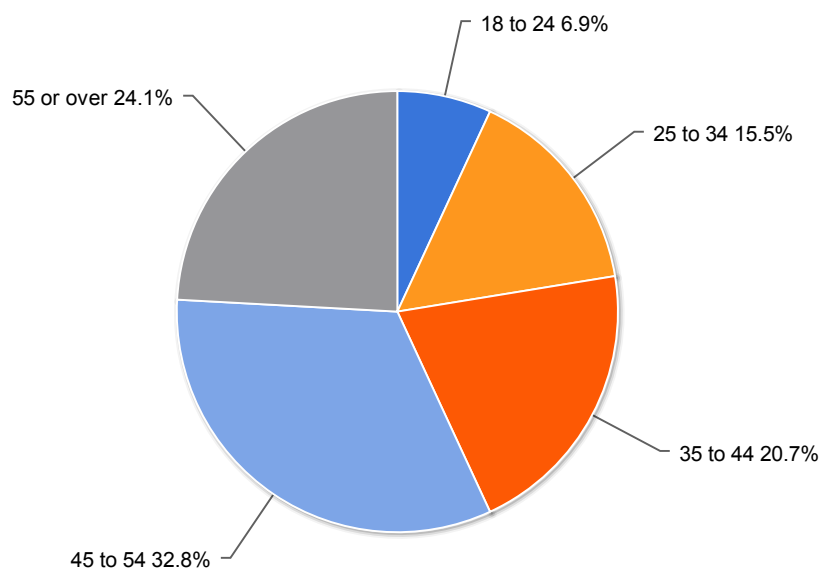
26. Are you:

Value	Count	Percent %
Male	41	68.3%
Female	19	31.7%

Statistics

Total Responses	60
-----------------	----

27. What is your age?



27. What is your age?

Value	Count	Percent %
-------	-------	-----------

Statistics

Under 18	0	0.0%	Total Responses	58
18 to 24	4	6.9%	Sum	2,342.0
25 to 34	9	15.5%	Avg.	40.4
35 to 44	12	20.7%	StdDev	11.7
45 to 54	19	32.8%	Max	55.0
55 or over	14	24.1%		

28. Do you have any other thoughts or comments on transportation to/from Hanscom Field?

Count	Response
1	76 Bus driver at 6:20 a.m. is always late
1	Dangerous intersection at the entrance
1	I live 110 miles away none of it is going to work for me
1	Ready auto or bike access through the air base. It would cut off five miles of commute a day.
1	arrive/leave early
1	keep the bus it is busy no need to get rid of it.
1	no
1	no :)
1	More choices and times for arrivals and departures from Hanscom Field. I feel our public transportation system is inadequate and even more inadequate for people who live in the suburbs.
1	I need the bus 76 to get home, work, and school everyday. I've been using this bus for 10 months. It helps me and some of my other classmates. We need this to get to school. Education is important I trust my safety with the mbta. Please keep the line open. Thank you
1	I am neither a student, nor an employee. I rent a hanger and need to drive my car on an irregular schedule to Hanscom
1	I use the Battle Road Trail for 1/2 of my commute to work on a bicycle. However, we need a BIKE LANE on Virginia Rd and the other access roads.
1	Shave the 90 degree turn on Virginia Road (behind T hangars) and eliminate the stop sign there. Increase speed limit to 40 mph on Virginia Road along straight stretch behind RW 5. Offer rush-hour shuttle service to/from area around K-Mart or Roche Brothers in Acton.
1	Keep the bus route of 76 from Alewife to Hanscom so I can graduate from the National Aviation Academy

Appendix C-2

2012 Intersection Turning Movement Counts



PRECISION
D A T A
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P.O. Box 301 Berlin, MA 01503
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N/S: Jughandle/ Hartwell Avenue
E/W: Bedford Street (Route 4/225)
City, State: Lexington, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 A
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Jughandle From North				Bedford Road (Route 4/225) From East				Hartwell Avenue From South				Bedford Road (Route 4/225) From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
06:00 AM	0	144	13	0	0	61	1	0	16	0	1	0	76	120	0	0	432
06:15 AM	0	165	20	0	0	81	0	0	29	0	0	0	101	136	0	0	532
06:30 AM	0	198	31	0	0	119	0	0	31	0	10	0	107	208	0	0	704
06:45 AM	0	209	47	0	0	140	0	0	48	0	10	0	109	231	0	0	794
Total	0	716	111	0	0	401	1	0	124	0	21	0	393	695	0	0	2462
07:00 AM	0	189	47	0	0	144	0	0	52	0	17	0	109	243	0	0	801
07:15 AM	0	187	40	0	0	159	0	0	67	0	14	0	101	258	0	0	826
07:30 AM	0	181	46	0	0	156	0	0	69	0	5	0	109	275	0	0	841
07:45 AM	1	266	42	0	0	179	0	0	80	0	20	0	121	225	0	0	934
Total	1	823	175	0	0	638	0	0	268	0	56	0	440	1001	0	0	3402
08:00 AM	0	213	50	0	0	151	0	0	117	0	20	0	124	227	0	0	902
08:15 AM	0	238	48	0	0	155	0	0	97	0	16	0	94	226	0	0	874
08:30 AM	0	268	59	0	0	148	0	0	71	0	12	0	127	188	0	0	873
08:45 AM	0	231	63	0	0	176	0	0	76	0	12	0	103	200	0	0	861
Total	0	950	220	0	0	630	0	0	361	0	60	0	448	841	0	0	3510
Grand Total	1	2489	506	0	0	1669	1	0	753	0	137	0	1281	2537	0	0	9374
Apprch %	0	83.1	16.9	0	0	99.9	0.1	0	84.6	0	15.4	0	33.6	66.4	0	0	
Total %	0	26.6	5.4	0	0	17.8	0	0	8	0	1.5	0	13.7	27.1	0	0	
Cars	1	2425	498	0	0	1597	1	0	686	0	128	0	1271	2468	0	0	9075
% Cars	100	97.4	98.4	0	0	95.7	100	0	91.1	0	93.4	0	99.2	97.3	0	0	96.8
Heavy Vehicles	0	64	8	0	0	72	0	0	67	0	9	0	10	69	0	0	299
% Heavy Vehicles	0	2.6	1.6	0	0	4.3	0	0	8.9	0	6.6	0	0.8	2.7	0	0	3.2

	Jughandle From North					Bedford Road (Route 4/225) From East					Hartwell Avenue From South					Bedford Road (Route 4/225) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:45 AM																					
07:45 AM	1	266	42	0	309	0	179	0	0	179	80	0	20	0	100	121	225	0	0	346	934
08:00 AM	0	213	50	0	263	0	151	0	0	151	117	0	20	0	137	124	227	0	0	351	902
08:15 AM	0	238	48	0	286	0	155	0	0	155	97	0	16	0	113	94	226	0	0	320	874
08:30 AM	0	268	59	0	327	0	148	0	0	148	71	0	12	0	83	127	188	0	0	315	873
Total Volume	1	985	199	0	1185	0	633	0	0	633	365	0	68	0	433	466	866	0	0	1332	3583
% App. Total	0.1	83.1	16.8	0		0	100	0	0		84.3	0	15.7	0		35	65	0	0		
PHF	.250	.919	.843	.000	.906	.000	.884	.000	.000	.884	.780	.000	.850	.000	.790	.917	.954	.000	.000	.949	.959
Cars	1	959	196	0	1156	0	607	0	0	607	335	0	64	0	399	465	841	0	0	1306	3468
% Cars	100	97.4	98.5	0	97.6	0	95.9	0	0	95.9	91.8	0	94.1	0	92.1	99.8	97.1	0	0	98.0	96.8
Heavy Vehicles	0	26	3	0	29	0	26	0	0	26	30	0	4	0	34	1	25	0	0	26	115
% Heavy Vehicles	0	2.6	1.5	0	2.4	0	4.1	0	0	4.1	8.2	0	5.9	0	7.9	0.2	2.9	0	0	2.0	3.2



PRECISION
D A T A
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N/S: Jughandle/ Hartwell Avenue
E/W: Bedford Street (Route 4/225)
City, State: Lexington, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 A
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars

	Jughandle From North				Bedford Road (Route 4/225) From East				Hartwell Avenue From South				Bedford Road (Route 4/225) From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
06:00 AM	0	141	13	0	0	58	1	0	15	0	1	0	76	115	0	0	420
06:15 AM	0	163	18	0	0	77	0	0	24	0	0	0	99	134	0	0	515
06:30 AM	0	196	31	0	0	115	0	0	30	0	6	0	106	203	0	0	687
06:45 AM	0	204	47	0	0	130	0	0	44	0	9	0	107	228	0	0	769
Total	0	704	109	0	0	380	1	0	113	0	16	0	388	680	0	0	2391
07:00 AM	0	182	47	0	0	141	0	0	49	0	17	0	107	238	0	0	781
07:15 AM	0	182	39	0	0	155	0	0	57	0	14	0	100	248	0	0	795
07:30 AM	0	175	44	0	0	151	0	0	66	0	5	0	109	267	0	0	817
07:45 AM	1	261	42	0	0	171	0	0	72	0	20	0	121	218	0	0	906
Total	1	800	172	0	0	618	0	0	244	0	56	0	437	971	0	0	3299
08:00 AM	0	209	49	0	0	143	0	0	106	0	19	0	124	220	0	0	870
08:15 AM	0	226	47	0	0	147	0	0	91	0	15	0	94	221	0	0	841
08:30 AM	0	263	58	0	0	146	0	0	66	0	10	0	126	182	0	0	851
08:45 AM	0	223	63	0	0	163	0	0	66	0	12	0	102	194	0	0	823
Total	0	921	217	0	0	599	0	0	329	0	56	0	446	817	0	0	3385
Grand Total	1	2425	498	0	0	1597	1	0	686	0	128	0	1271	2468	0	0	9075
Apprch %	0	82.9	17	0	0	99.9	0.1	0	84.3	0	15.7	0	34	66	0	0	
Total %	0	26.7	5.5	0	0	17.6	0	0	7.6	0	1.4	0	14	27.2	0	0	

	Jughandle From North					Bedford Road (Route 4/225) From East					Hartwell Avenue From South					Bedford Road (Route 4/225) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:45 AM																					
07:45 AM	1	261	42	0	304	0	171	0	0	171	72	0	20	0	92	121	218	0	0	339	906
08:00 AM	0	209	49	0	258	0	143	0	0	143	106	0	19	0	125	124	220	0	0	344	870
08:15 AM	0	226	47	0	273	0	147	0	0	147	91	0	15	0	106	94	221	0	0	315	841
08:30 AM	0	263	58	0	321	0	146	0	0	146	66	0	10	0	76	126	182	0	0	308	851
Total Volume	1	959	196	0	1156	0	607	0	0	607	335	0	64	0	399	465	841	0	0	1306	3468
% App. Total	0.1	83	17	0		0	100	0	0		84	0	16	0		35.6	64.4	0	0		
PHF	.250	.912	.845	.000	.900	.000	.887	.000	.000	.887	.790	.000	.800	.000	.798	.923	.951	.000	.000	.949	.957



PRECISION
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N/S: Jughandle/ Hartwell Avenue
E/W: Bedford Street (Route 4/225)
City, State: Lexington, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 A
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

	Jughandle From North				Bedford Road (Route 4/225) From East				Hartwell Avenue From South				Bedford Road (Route 4/225) From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
06:00 AM	0	3	0	0	0	3	0	0	1	0	0	0	0	5	0	0	12
06:15 AM	0	2	2	0	0	4	0	0	5	0	0	0	2	2	0	0	17
06:30 AM	0	2	0	0	0	4	0	0	1	0	4	0	1	5	0	0	17
06:45 AM	0	5	0	0	0	10	0	0	4	0	1	0	2	3	0	0	25
Total	0	12	2	0	0	21	0	0	11	0	5	0	5	15	0	0	71
07:00 AM	0	7	0	0	0	3	0	0	3	0	0	0	2	5	0	0	20
07:15 AM	0	5	1	0	0	4	0	0	10	0	0	0	1	10	0	0	31
07:30 AM	0	6	2	0	0	5	0	0	3	0	0	0	0	8	0	0	24
07:45 AM	0	5	0	0	0	8	0	0	8	0	0	0	0	7	0	0	28
Total	0	23	3	0	0	20	0	0	24	0	0	0	3	30	0	0	103
08:00 AM	0	4	1	0	0	8	0	0	11	0	1	0	0	7	0	0	32
08:15 AM	0	12	1	0	0	8	0	0	6	0	1	0	0	5	0	0	33
08:30 AM	0	5	1	0	0	2	0	0	5	0	2	0	1	6	0	0	22
08:45 AM	0	8	0	0	0	13	0	0	10	0	0	0	1	6	0	0	38
Total	0	29	3	0	0	31	0	0	32	0	4	0	2	24	0	0	125
Grand Total	0	64	8	0	0	72	0	0	67	0	9	0	10	69	0	0	299
Apprch %	0	88.9	11.1	0	0	100	0	0	88.2	0	11.8	0	12.7	87.3	0	0	
Total %	0	21.4	2.7	0	0	24.1	0	0	22.4	0	3	0	3.3	23.1	0	0	

	Jughandle From North					Bedford Road (Route 4/225) From East					Hartwell Avenue From South					Bedford Road (Route 4/225) From West					Int. Total
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 08:00 AM																					
08:00 AM	0	4	1	0	5	0	8	0	0	8	11	0	1	0	12	0	7	0	0	7	32
08:15 AM	0	12	1	0	13	0	8	0	0	8	6	0	1	0	7	0	5	0	0	5	33
08:30 AM	0	5	1	0	6	0	2	0	0	2	5	0	2	0	7	1	6	0	0	7	22
08:45 AM	0	8	0	0	8	0	13	0	0	13	10	0	0	0	10	1	6	0	0	7	38
Total Volume	0	29	3	0	32	0	31	0	0	31	32	0	4	0	36	2	24	0	0	26	125
% App. Total	0	90.6	9.4	0		0	100	0	0		88.9	0	11.1	0		7.7	92.3	0	0		
PHF	.000	.604	.750	.000	.615	.000	.596	.000	.000	.596	.727	.000	.500	.000	.750	.500	.857	.000	.000	.929	.822



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N/S: Jughandle/ Hartwell Avenue
E/W: Bedford Street (Route 4/225)
City, State: Lexington, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 A
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

	Jughandle From North				Bedford Road (Route 4/225) From East				Hartwell Avenue From South				Bedford Road (Route 4/225) From West				Int. Total
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	
06:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
06:15 AM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
06:30 AM	0	0	0	0	0	0	0	4	0	0	0	4	0	0	0	0	8
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Total	0	0	0	0	0	0	0	4	1	0	0	4	0	2	0	0	11
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
07:30 AM	0	0	0	2	0	0	0	1	0	0	0	1	0	0	0	2	6
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	2	0	0	0	1	0	0	1	1	0	0	0	2	7
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	2
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	2
Grand Total	0	0	0	3	0	0	0	5	1	0	1	5	0	2	0	3	20
Apprch %	0	0	0	100	0	0	0	100	14.3	0	14.3	71.4	0	40	0	60	
Total %	0	0	0	15	0	0	0	25	5	0	5	25	0	10	0	15	

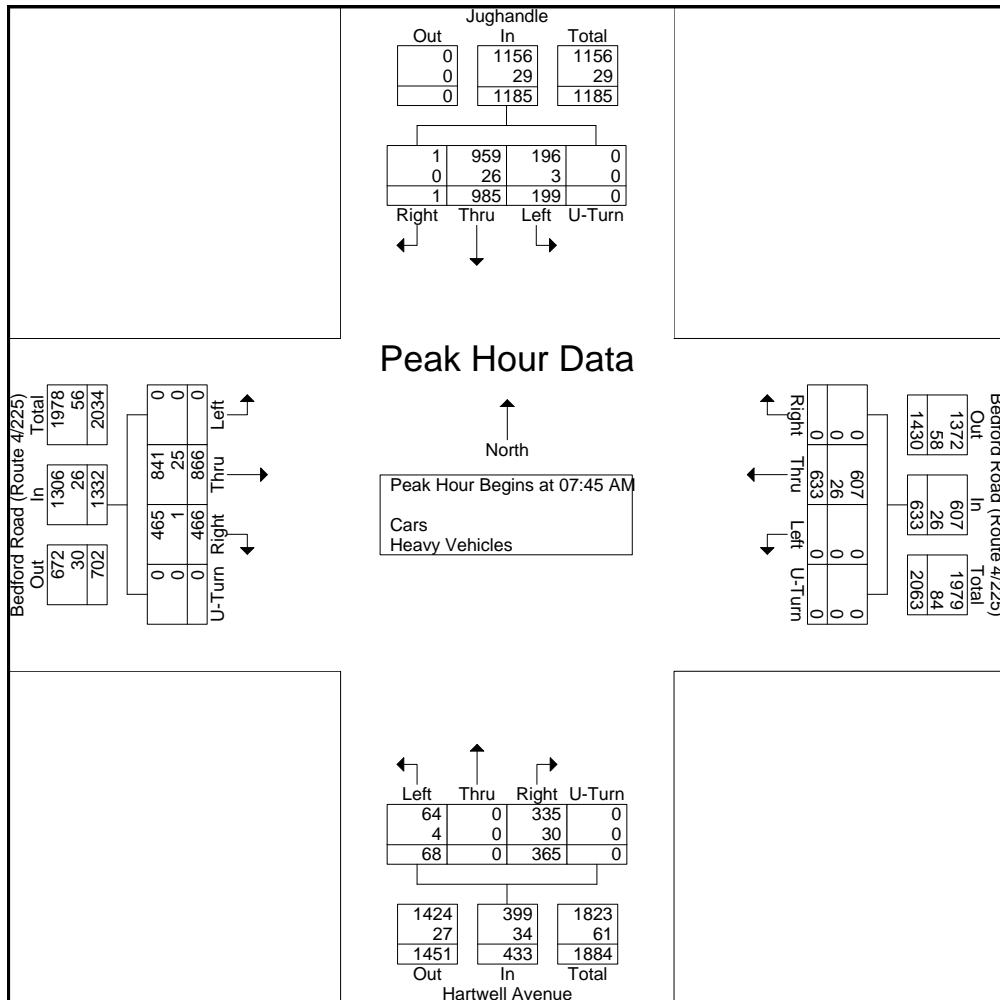
	Jughandle From North					Bedford Road (Route 4/225) From East					Hartwell Avenue From South					Bedford Road (Route 4/225) From West					Int. Total
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 06:00 AM																					
06:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
06:15 AM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1
06:30 AM	0	0	0	0	0	0	0	0	4	4	0	0	0	4	4	0	0	0	0	0	8
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
Total Volume	0	0	0	0	0	0	0	0	4	4	1	0	0	4	5	0	2	0	0	2	11
% App. Total	0	0	0	0		0	0	0	100		20	0	0	80		0	100	0	0		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.250	.250	.250	.000	.000	.250	.313	.000	.500	.000	.000	.500	.344

N/S: Jughandle/ Hartwell Avenue
 E/W: Bedford Street (Route 4/225)
 City, State: Lexington, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 A
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

	Jughandle From North					Bedford Road (Route 4/225) From East					Hartwell Avenue From South					Bedford Road (Route 4/225) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:45 AM																					
07:45 AM	1	266	42	0	309	0	179	0	0	179	80	0	20	0	100	121	225	0	0	346	934
08:00 AM	0	213	50	0	263	0	151	0	0	151	117	0	20	0	137	124	227	0	0	351	902
08:15 AM	0	238	48	0	286	0	155	0	0	155	97	0	16	0	113	94	226	0	0	320	874
08:30 AM	0	268	59	0	327	0	148	0	0	148	71	0	12	0	83	127	188	0	0	315	873
Total Volume	1	985	199	0	1185	0	633	0	0	633	365	0	68	0	433	466	866	0	0	1332	3583
% App. Total	0.1	83.1	16.8	0		0	100	0	0		84.3	0	15.7	0		35	65	0	0		
PHF	.250	.919	.843	.000	.906	.000	.884	.000	.000	.884	.780	.000	.850	.000	.790	.917	.954	.000	.000	.949	.959
Cars	1	959	196	0	1156	0	607	0	0	607	335	0	64	0	399	465	841	0	0	1306	3468
% Cars	100	97.4	98.5	0	97.6	0	95.9	0	0	95.9	91.8	0	94.1	0	92.1	99.8	97.1	0	0	98.0	96.8
Heavy Vehicles	0	26	3	0	29	0	26	0	0	26	30	0	4	0	34	1	25	0	0	26	115
% Heavy Vehicles	0	2.6	1.5	0	2.4	0	4.1	0	0	4.1	8.2	0	5.9	0	7.9	0.2	2.9	0	0	2.0	3.2





PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

N/S: Massachusetts Avenue/ Cranberry Hill
E/W: Marrett Road (Route 2A)
City, State: Lexington, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 B
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Massachusetts Avenue From North				Marrett Road (Route 2A) From East				Cranberry Hill From South				Marrett Road (Route 2A) From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
06:00 AM	3	1	13	0	33	91	9	0	2	0	0	0	1	33	8	0	194
06:15 AM	3	0	23	0	38	118	10	0	0	0	0	0	1	50	8	0	251
06:30 AM	10	1	28	0	46	127	12	0	1	0	0	0	2	84	12	0	323
06:45 AM	12	4	25	0	58	150	21	0	2	0	0	0	2	88	21	0	383
Total	28	6	89	0	175	486	52	0	5	0	0	0	6	255	49	0	1151
07:00 AM	28	5	53	0	59	166	28	0	5	1	1	0	4	103	22	0	475
07:15 AM	19	14	62	0	76	150	54	0	16	0	0	0	5	137	23	0	556
07:30 AM	33	23	55	0	65	146	74	0	26	5	2	0	2	150	24	0	605
07:45 AM	33	18	83	0	85	156	37	0	20	14	4	0	5	159	33	0	647
Total	113	60	253	0	285	618	193	0	67	20	7	0	16	549	102	0	2283
08:00 AM	33	7	79	0	85	115	31	0	12	5	0	0	3	165	30	0	565
08:15 AM	39	18	82	0	99	117	29	0	7	3	1	0	8	157	32	0	592
08:30 AM	38	5	92	0	88	103	19	0	9	5	4	0	7	164	38	0	572
08:45 AM	27	6	72	0	86	126	34	0	4	3	1	0	14	146	42	0	561
Total	137	36	325	0	358	461	113	0	32	16	6	0	32	632	142	0	2290
Grand Total	278	102	667	0	818	1565	358	0	104	36	13	0	54	1436	293	0	5724
Apprch %	26.6	9.7	63.7	0	29.8	57.1	13.1	0	68	23.5	8.5	0	3	80.5	16.4	0	
Total %	4.9	1.8	11.7	0	14.3	27.3	6.3	0	1.8	0.6	0.2	0	0.9	25.1	5.1	0	
Cars	268	99	656	0	799	1495	346	0	97	35	13	0	54	1390	280	0	5532
% Cars	96.4	97.1	98.4	0	97.7	95.5	96.6	0	93.3	97.2	100	0	100	96.8	95.6	0	96.6
Heavy Vehicles	10	3	11	0	19	70	12	0	7	1	0	0	0	46	13	0	192
% Heavy Vehicles	3.6	2.9	1.6	0	2.3	4.5	3.4	0	6.7	2.8	0	0	0	3.2	4.4	0	3.4

	Massachusetts Avenue From North					Marrett Road (Route 2A) From East					Cranberry Hill From South					Marrett Road (Route 2A) From West					Int. Total
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
07:30 AM	33	23	55	0	111	65	146	74	0	285	26	5	2	0	33	2	150	24	0	176	605
07:45 AM	33	18	83	0	134	85	156	37	0	278	20	14	4	0	38	5	159	33	0	197	647
08:00 AM	33	7	79	0	119	85	115	31	0	231	12	5	0	0	17	3	165	30	0	198	565
08:15 AM	39	18	82	0	139	99	117	29	0	245	7	3	1	0	11	8	157	32	0	197	592
Total Volume	138	66	299	0	503	334	534	171	0	1039	65	27	7	0	99	18	631	119	0	768	2409
% App. Total	27.4	13.1	59.4	0		32.1	51.4	16.5	0		65.7	27.3	7.1	0		2.3	82.2	15.5	0		
PHF	.885	.717	.901	.000	.905	.843	.856	.578	.000	.911	.625	.482	.438	.000	.651	.563	.956	.902	.000	.970	.931
Cars	134	65	295	0	494	323	510	162	0	995	62	26	7	0	95	18	609	114	0	741	2325
% Cars	97.1	98.5	98.7	0	98.2	96.7	95.5	94.7	0	95.8	95.4	96.3	100	0	96.0	100	96.5	95.8	0	96.5	96.5
Heavy Vehicles	4	1	4	0	9	11	24	9	0	44	3	1	0	0	4	0	22	5	0	27	84
% Heavy Vehicles	2.9	1.5	1.3	0	1.8	3.3	4.5	5.3	0	4.2	4.6	3.7	0	0	4.0	0	3.5	4.2	0	3.5	3.5

Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1
Peak Hour for Entire Intersection Begins at 07:30 AM

N/S: Massachusetts Avenue/ Cranberry Hill
 E/W: Marrett Road (Route 2A)
 City, State: Lexington, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 B
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

Groups Printed- Cars

	Massachusetts Avenue From North				Marrett Road (Route 2A) From East				Cranberry Hill From South				Marrett Road (Route 2A) From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
06:00 AM	2	1	13	0	33	88	9	0	2	0	0	0	1	32	8	0	189
06:15 AM	3	0	23	0	37	112	10	0	0	0	0	0	1	49	7	0	242
06:30 AM	9	1	28	0	46	124	12	0	0	0	0	0	2	82	12	0	316
06:45 AM	12	4	25	0	57	139	21	0	2	0	0	0	2	82	20	0	364
Total	26	6	89	0	173	463	52	0	4	0	0	0	6	245	47	0	1111
07:00 AM	27	4	50	0	59	161	27	0	4	1	1	0	4	103	21	0	462
07:15 AM	18	13	61	0	76	142	52	0	14	0	0	0	5	132	21	0	534
07:30 AM	32	22	54	0	63	139	67	0	23	4	2	0	2	142	24	0	574
07:45 AM	32	18	82	0	82	149	36	0	20	14	4	0	5	153	29	0	624
Total	109	57	247	0	280	591	182	0	61	19	7	0	16	530	95	0	2194
08:00 AM	31	7	77	0	84	111	31	0	12	5	0	0	3	161	30	0	552
08:15 AM	39	18	82	0	94	111	28	0	7	3	1	0	8	153	31	0	575
08:30 AM	37	5	90	0	85	96	19	0	9	5	4	0	7	158	36	0	551
08:45 AM	26	6	71	0	83	123	34	0	4	3	1	0	14	143	41	0	549
Total	133	36	320	0	346	441	112	0	32	16	6	0	32	615	138	0	2227
Grand Total	268	99	656	0	799	1495	346	0	97	35	13	0	54	1390	280	0	5532
Apprch %	26.2	9.7	64.1	0	30.3	56.6	13.1	0	66.9	24.1	9	0	3.1	80.6	16.2	0	
Total %	4.8	1.8	11.9	0	14.4	27	6.3	0	1.8	0.6	0.2	0	1	25.1	5.1	0	

	Massachusetts Avenue From North					Marrett Road (Route 2A) From East					Cranberry Hill From South					Marrett Road (Route 2A) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	32	22	54	0	108	63	139	67	0	269	23	4	2	0	29	2	142	24	0	168	574
07:45 AM	32	18	82	0	132	82	149	36	0	267	20	14	4	0	38	5	153	29	0	187	624
08:00 AM	31	7	77	0	115	84	111	31	0	226	12	5	0	0	17	3	161	30	0	194	552
08:15 AM	39	18	82	0	139	94	111	28	0	233	7	3	1	0	11	8	153	31	0	192	575
Total Volume	134	65	295	0	494	323	510	162	0	995	62	26	7	0	95	18	609	114	0	741	2325
% App. Total	27.1	13.2	59.7	0		32.5	51.3	16.3	0		65.3	27.4	7.4	0		2.4	82.2	15.4	0		
PHF	.859	.739	.899	.000	.888	.859	.856	.604	.000	.925	.674	.464	.438	.000	.625	.563	.946	.919	.000	.955	.931

N/S: Massachusetts Avenue/ Cranberry Hill
 E/W: Marrett Road (Route 2A)
 City, State: Lexington, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 B
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

Groups Printed- Heavy Vehicles

	Massachusetts Avenue From North				Marrett Road (Route 2A) From East				Cranberry Hill From South				Marrett Road (Route 2A) From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
06:00 AM	1	0	0	0	0	3	0	0	0	0	0	0	0	1	0	0	5
06:15 AM	0	0	0	0	1	6	0	0	0	0	0	0	0	1	1	0	9
06:30 AM	1	0	0	0	0	3	0	0	1	0	0	0	0	2	0	0	7
06:45 AM	0	0	0	0	1	11	0	0	0	0	0	0	0	6	1	0	19
Total	2	0	0	0	2	23	0	0	1	0	0	0	0	10	2	0	40
07:00 AM	1	1	3	0	0	5	1	0	1	0	0	0	0	0	1	0	13
07:15 AM	1	1	1	0	0	8	2	0	2	0	0	0	0	5	2	0	22
07:30 AM	1	1	1	0	2	7	7	0	3	1	0	0	0	8	0	0	31
07:45 AM	1	0	1	0	3	7	1	0	0	0	0	0	0	6	4	0	23
Total	4	3	6	0	5	27	11	0	6	1	0	0	0	19	7	0	89
08:00 AM	2	0	2	0	1	4	0	0	0	0	0	0	0	4	0	0	13
08:15 AM	0	0	0	0	5	6	1	0	0	0	0	0	0	4	1	0	17
08:30 AM	1	0	2	0	3	7	0	0	0	0	0	0	0	6	2	0	21
08:45 AM	1	0	1	0	3	3	0	0	0	0	0	0	0	3	1	0	12
Total	4	0	5	0	12	20	1	0	0	0	0	0	0	17	4	0	63
Grand Total	10	3	11	0	19	70	12	0	7	1	0	0	0	46	13	0	192
Apprch %	41.7	12.5	45.8	0	18.8	69.3	11.9	0	87.5	12.5	0	0	0	78	22	0	
Total %	5.2	1.6	5.7	0	9.9	36.5	6.2	0	3.6	0.5	0	0	0	24	6.8	0	

	Massachusetts Avenue From North					Marrett Road (Route 2A) From East					Cranberry Hill From South					Marrett Road (Route 2A) From West					Int. Total
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	1	1	3	0	5	0	5	1	0	6	1	0	0	0	1	0	0	1	0	1	13
07:15 AM	1	1	1	0	3	0	8	2	0	10	2	0	0	0	2	0	5	2	0	7	22
07:30 AM	1	1	1	0	3	2	7	7	0	16	3	1	0	0	4	0	8	0	0	8	31
07:45 AM	1	0	1	0	2	3	7	1	0	11	0	0	0	0	0	0	6	4	0	10	23
Total Volume	4	3	6	0	13	5	27	11	0	43	6	1	0	0	7	0	19	7	0	26	89
% App. Total	30.8	23.1	46.2	0		11.6	62.8	25.6	0		85.7	14.3	0	0		0	73.1	26.9	0		
PHF	1.00	.750	.500	.000	.650	.417	.844	.393	.000	.672	.500	.250	.000	.000	.438	.000	.594	.438	.000	.650	.718

N/S: Massachusetts Avenue/ Cranberry Hill
 E/W: Marrett Road (Route 2A)
 City, State: Lexington, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 B
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

Groups Printed- Peds and Bicycles

	Massachusetts Avenue From North				Marrett Road (Route 2A) From East				Cranberry Hill From South				Marrett Road (Route 2A) From West				Int. Total
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	
06:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
06:15 AM	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2
06:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	3
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	2
Total	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	2
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Grand Total	1	0	1	1	0	0	1	0	0	0	0	0	0	1	0	1	6
Apprch %	33.3	0	33.3	33.3	0	0	100	0	0	0	0	0	0	50	0	50	
Total %	16.7	0	16.7	16.7	0	0	16.7	0	0	0	0	0	0	16.7	0	16.7	

	Massachusetts Avenue From North					Marrett Road (Route 2A) From East					Cranberry Hill From South					Marrett Road (Route 2A) From West					Int. Total
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 06:00 AM																					
06:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
06:15 AM	0	0	1	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	2
06:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	1	0	1	0	0	1	0	1	0	0	0	0	0	0	1	0	0	1	3
% App. Total	0	0	100	0		0	0	100	0		0	0	0	0		0	100	0	0		
PHF	.000	.000	.250	.000	.250	.000	.000	.250	.000	.250	.000	.000	.000	.000	.000	.000	.250	.000	.000	.250	.375



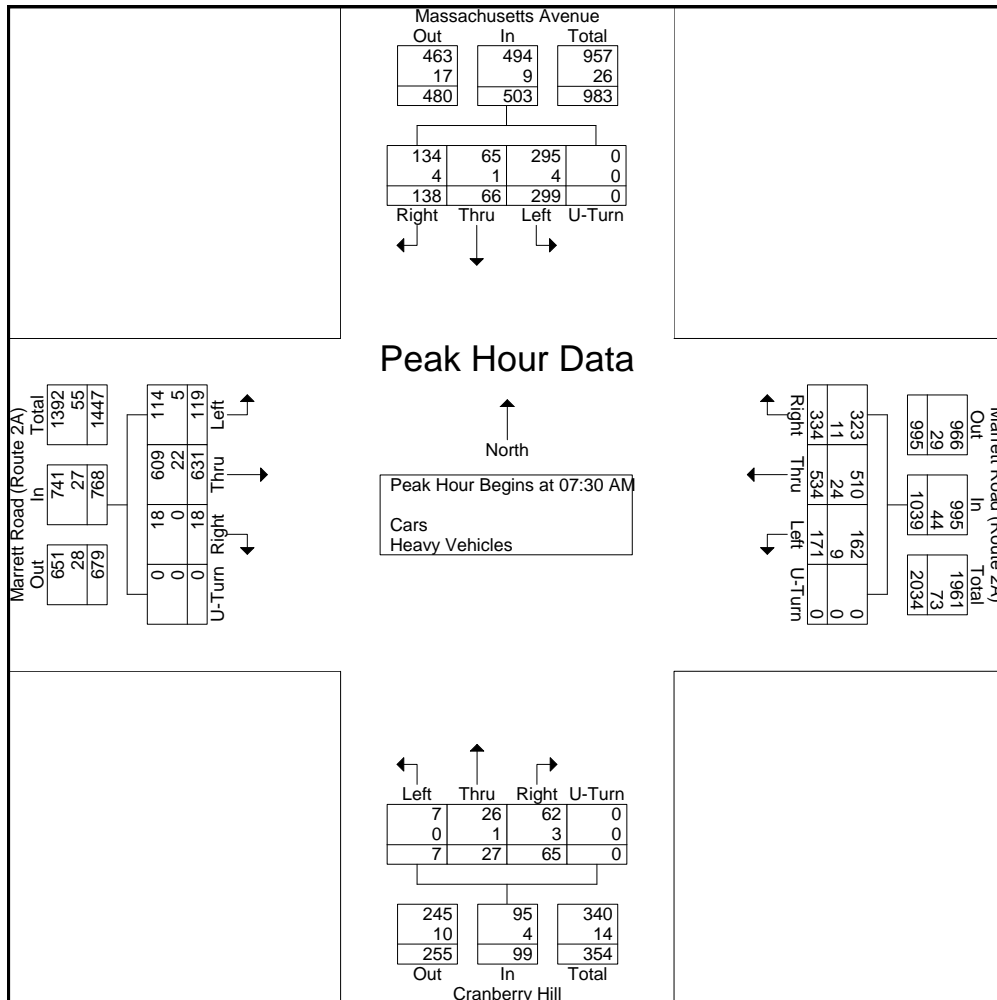
PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

N/S: Massachusetts Avenue/ Cranberry Hill
E/W: Marrett Road (Route 2A)
City, State: Lexington, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 B
Site Code : TBA
Start Date : 11/13/2012
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	Massachusetts Avenue From North					Marrett Road (Route 2A) From East					Cranberry Hill From South					Marrett Road (Route 2A) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	33	23	55	0	111	65	146	74	0	285	26	5	2	0	33	2	150	24	0	176	605
07:45 AM	33	18	83	0	134	85	156	37	0	278	20	14	4	0	38	5	159	33	0	197	647
08:00 AM	33	7	79	0	119	85	115	31	0	231	12	5	0	0	17	3	165	30	0	198	565
08:15 AM	39	18	82	0	139	99	117	29	0	245	7	3	1	0	11	8	157	32	0	197	592
Total Volume	138	66	299	0	503	334	534	171	0	1039	65	27	7	0	99	18	631	119	0	768	2409
% App. Total	27.4	13.1	59.4	0		32.1	51.4	16.5	0		65.7	27.3	7.1	0		2.3	82.2	15.5	0		
PHF	.885	.717	.901	.000	.905	.843	.856	.578	.000	.911	.625	.482	.438	.000	.651	.563	.956	.902	.000	.970	.931
Cars	134	65	295	0	494	323	510	162	0	995	62	26	7	0	95	18	609	114	0	741	2325
% Cars	97.1	98.5	98.7	0	98.2	96.7	95.5	94.7	0	95.8	95.4	96.3	100	0	96.0	100	96.5	95.8	0	96.5	96.5
Heavy Vehicles	4	1	4	0	9	11	24	9	0	44	3	1	0	0	4	0	22	5	0	27	84
% Heavy Vehicles	2.9	1.5	1.3	0	1.8	3.3	4.5	5.3	0	4.2	4.6	3.7	0	0	4.0	0	3.5	4.2	0	3.5	3.5



N: Old Massachusetts Avenue
 E/W: Marrett Road (Route 2A)/ Mass Ave
 City, State: Lexington, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 C
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Old Massachusetts Avenue From North			Marrett Road (Route 2A) From East			Massachusetts Avenue (Route 2A) From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
06:00 AM	5	0	0	0	97	0	42	8	0	152
06:15 AM	4	0	0	1	120	0	60	13	0	198
06:30 AM	6	4	0	1	139	0	92	23	0	265
06:45 AM	6	0	0	1	155	0	113	21	0	296
Total	21	4	0	3	511	0	307	65	0	911
07:00 AM	14	1	0	0	201	0	128	19	0	363
07:15 AM	15	2	0	1	161	0	165	21	0	365
07:30 AM	20	2	0	0	186	0	183	22	0	413
07:45 AM	29	3	0	1	191	0	190	30	0	444
Total	78	8	0	2	739	0	666	92	0	1585
08:00 AM	25	3	0	3	140	0	195	27	0	393
08:15 AM	23	1	0	2	156	0	196	35	0	413
08:30 AM	28	4	0	2	141	0	209	37	0	421
08:45 AM	27	0	0	0	160	0	193	39	0	419
Total	103	8	0	7	597	0	793	138	0	1646
Grand Total	202	20	0	12	1847	0	1766	295	0	4142
Apprch %	91	9	0	0.6	99.4	0	85.7	14.3	0	
Total %	4.9	0.5	0	0.3	44.6	0	42.6	7.1	0	
Cars	190	20	0	7	1774	0	1707	292	0	3990
% Cars	94.1	100	0	58.3	96	0	96.7	99	0	96.3
Heavy Vehicles	12	0	0	5	73	0	59	3	0	152
% Heavy Vehicles	5.9	0	0	41.7	4	0	3.3	1	0	3.7

	Old Massachusetts Avenue From North				Marrett Road (Route 2A) From East				Massachusetts Avenue (Route 2A) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:45 AM													
07:45 AM	29	3	0	32	1	191	0	192	190	30	0	220	444
08:00 AM	25	3	0	28	3	140	0	143	195	27	0	222	393
08:15 AM	23	1	0	24	2	156	0	158	196	35	0	231	413
08:30 AM	28	4	0	32	2	141	0	143	209	37	0	246	421
Total Volume	105	11	0	116	8	628	0	636	790	129	0	919	1671
% App. Total	90.5	9.5	0		1.3	98.7	0		86	14	0		
PHF	.905	.688	.000	.906	.667	.822	.000	.828	.945	.872	.000	.934	.941
Cars	100	11	0	111	6	602	0	608	763	127	0	890	1609
% Cars	95.2	100	0	95.7	75.0	95.9	0	95.6	96.6	98.4	0	96.8	96.3
Heavy Vehicles	5	0	0	5	2	26	0	28	27	2	0	29	62
% Heavy Vehicles	4.8	0	0	4.3	25.0	4.1	0	4.4	3.4	1.6	0	3.2	3.7



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

N: Old Massachusetts Avenue
E/W: Marrett Road (Route 2A)/ Mass Ave
City, State: Lexington, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 C
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars

	Old Massachusetts Avenue From North			Marrett Road (Route 2A) From East			Massachusetts Avenue (Route 2A) From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
06:00 AM	4	0	0	0	91	0	40	8	0	143
06:15 AM	4	0	0	0	116	0	58	13	0	191
06:30 AM	5	4	0	1	135	0	90	23	0	258
06:45 AM	6	0	0	0	146	0	106	21	0	279
Total	19	4	0	1	488	0	294	65	0	871
07:00 AM	12	1	0	0	194	0	127	19	0	353
07:15 AM	15	2	0	0	155	0	160	21	0	353
07:30 AM	18	2	0	0	178	0	174	22	0	394
07:45 AM	27	3	0	1	183	0	180	28	0	422
Total	72	8	0	1	710	0	641	90	0	1522
08:00 AM	25	3	0	2	135	0	191	27	0	383
08:15 AM	21	1	0	2	149	0	190	35	0	398
08:30 AM	27	4	0	1	135	0	202	37	0	406
08:45 AM	26	0	0	0	157	0	189	38	0	410
Total	99	8	0	5	576	0	772	137	0	1597
Grand Total	190	20	0	7	1774	0	1707	292	0	3990
Apprch %	90.5	9.5	0	0.4	99.6	0	85.4	14.6	0	
Total %	4.8	0.5	0	0.2	44.5	0	42.8	7.3	0	

	Old Massachusetts Avenue From North				Marrett Road (Route 2A) From East				Massachusetts Avenue (Route 2A) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:45 AM													
07:45 AM	27	3	0	30	1	183	0	184	180	28	0	208	422
08:00 AM	25	3	0	28	2	135	0	137	191	27	0	218	383
08:15 AM	21	1	0	22	2	149	0	151	190	35	0	225	398
08:30 AM	27	4	0	31	1	135	0	136	202	37	0	239	406
Total Volume	100	11	0	111	6	602	0	608	763	127	0	890	1609
% App. Total	90.1	9.9	0		1	99	0		85.7	14.3	0		
PHF	.926	.688	.000	.895	.750	.822	.000	.826	.944	.858	.000	.931	.953

N: Old Massachusetts Avenue
 E/W: Marrett Road (Route 2A)/ Mass Ave
 City, State: Lexington, MA
 Client: Toole Engineering/ C. Fink



PRECISION
 DATA
 INDUSTRIES, LLC
 P.O. Box 301 Berlin, MA 01503
 Office: 508.481.3999 Fax: 508.545.1234
 Email: datarequests@pdillc.com

File Name : 123082 C
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

Groups Printed- Heavy Vehicles

	Old Massachusetts Avenue From North			Marrett Road (Route 2A) From East			Massachusetts Avenue (Route 2A) From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
06:00 AM	1	0	0	0	6	0	2	0	0	9
06:15 AM	0	0	0	1	4	0	2	0	0	7
06:30 AM	1	0	0	0	4	0	2	0	0	7
06:45 AM	0	0	0	1	9	0	7	0	0	17
Total	2	0	0	2	23	0	13	0	0	40
07:00 AM	2	0	0	0	7	0	1	0	0	10
07:15 AM	0	0	0	1	6	0	5	0	0	12
07:30 AM	2	0	0	0	8	0	9	0	0	19
07:45 AM	2	0	0	0	8	0	10	2	0	22
Total	6	0	0	1	29	0	25	2	0	63
08:00 AM	0	0	0	1	5	0	4	0	0	10
08:15 AM	2	0	0	0	7	0	6	0	0	15
08:30 AM	1	0	0	1	6	0	7	0	0	15
08:45 AM	1	0	0	0	3	0	4	1	0	9
Total	4	0	0	2	21	0	21	1	0	49
Grand Total	12	0	0	5	73	0	59	3	0	152
Apprch %	100	0	0	6.4	93.6	0	95.2	4.8	0	
Total %	7.9	0	0	3.3	48	0	38.8	2	0	

	Old Massachusetts Avenue From North				Marrett Road (Route 2A) From East				Massachusetts Avenue (Route 2A) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:30 AM													
07:30 AM	2	0	0	2	0	8	0	8	9	0	0	9	19
07:45 AM	2	0	0	2	0	8	0	8	10	2	0	12	22
08:00 AM	0	0	0	0	1	5	0	6	4	0	0	4	10
08:15 AM	2	0	0	2	0	7	0	7	6	0	0	6	15
Total Volume	6	0	0	6	1	28	0	29	29	2	0	31	66
% App. Total	100	0	0		3.4	96.6	0		93.5	6.5	0		
PHF	.750	.000	.000	.750	.250	.875	.000	.906	.725	.250	.000	.646	.750



PRECISION
D A T A
INDUSTRIES, LLC

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Email: datarequests@pdillc.com

N: Old Massachusetts Avenue
E/W: Marrett Road (Route 2A)/ Mass Ave
City, State: Lexington, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 C
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

	Old Massachusetts Avenue From North			Marrett Road (Route 2A) From East			Massachusetts Avenue (Route 2A) From West			
Start Time	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	Int. Total
06:00 AM	0	0	0	0	0	0	1	0	0	1
06:15 AM	0	0	0	1	0	0	0	0	0	1
06:30 AM	0	0	0	0	0	0	0	0	0	0
06:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	1	0	0	1	0	0	2
07:00 AM	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	1	0	0	1
07:30 AM	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	1	0	0	1
08:00 AM	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	1	0	0	0	0	1
08:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	1	0	0	0	0	1
Grand Total	0	0	0	1	1	0	2	0	0	4
Apprch %	0	0	0	50	50	0	100	0	0	
Total %	0	0	0	25	25	0	50	0	0	

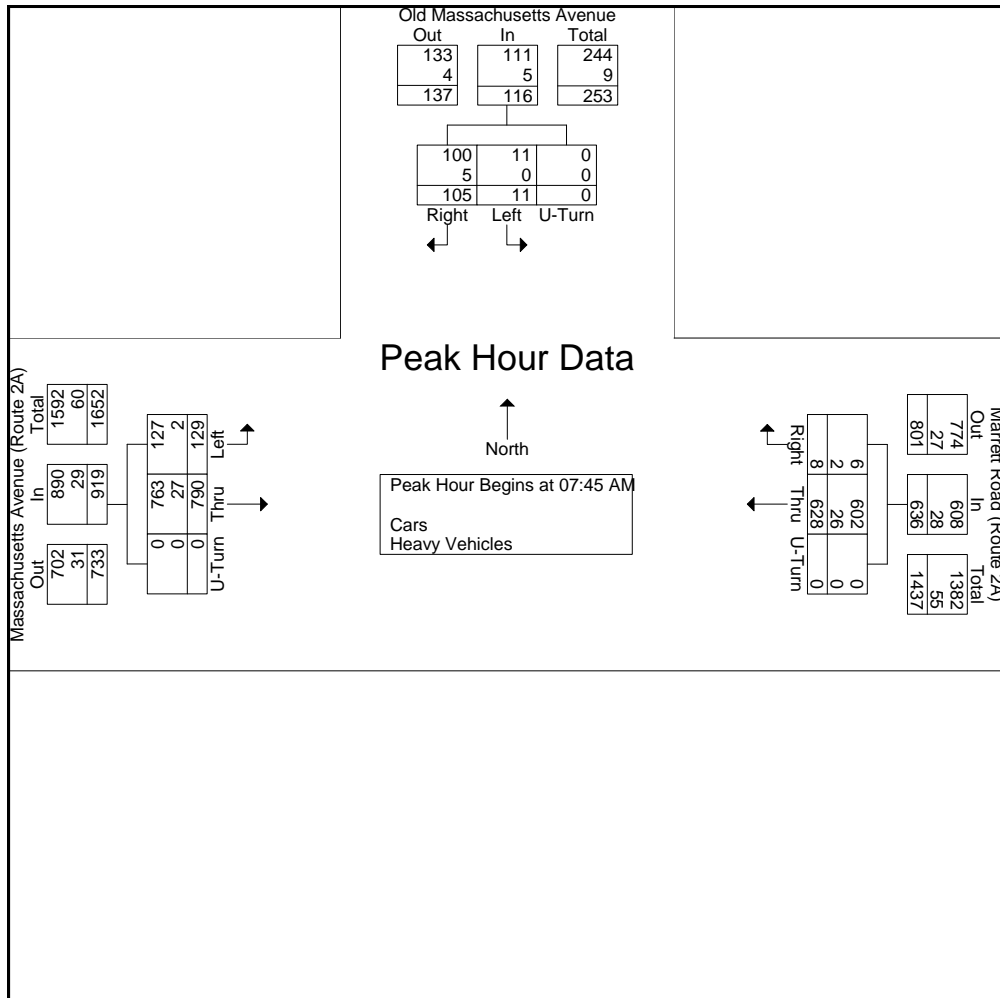
	Old Massachusetts Avenue From North				Marrett Road (Route 2A) From East				Massachusetts Avenue (Route 2A) From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 06:00 AM													
06:00 AM	0	0	0	0	0	0	0	0	1	0	0	1	1
06:15 AM	0	0	0	0	1	0	0	1	0	0	0	0	1
06:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	1	0	0	1	1	0	0	1	2
% App. Total	0	0	0		100	0	0		100	0	0		
PHF	.000	.000	.000	.000	.250	.000	.000	.250	.250	.000	.000	.250	.500

N: Old Massachusetts Avenue
 E/W: Marrett Road (Route 2A)/ Mass Ave
 City, State: Lexington, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 C
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

	Old Massachusetts Avenue				Marrett Road (Route 2A)				Massachusetts Avenue (Route 2A)				
	From North				From East				From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:45 AM													
07:45 AM	29	3	0	32	1	191	0	192	190	30	0	220	444
08:00 AM	25	3	0	28	3	140	0	143	195	27	0	222	393
08:15 AM	23	1	0	24	2	156	0	158	196	35	0	231	413
08:30 AM	28	4	0	32	2	141	0	143	209	37	0	246	421
Total Volume	105	11	0	116	8	628	0	636	790	129	0	919	1671
% App. Total	90.5	9.5	0		1.3	98.7	0		86	14	0		
PHF	.905	.688	.000	.906	.667	.822	.000	.828	.945	.872	.000	.934	.941
Cars	100	11	0	111	6	602	0	608	763	127	0	890	1609
% Cars	95.2	100	0	95.7	75.0	95.9	0	95.6	96.6	98.4	0	96.8	96.3
Heavy Vehicles	5	0	0	5	2	26	0	28	27	2	0	29	62
% Heavy Vehicles	4.8	0	0	4.3	25.0	4.1	0	4.4	3.4	1.6	0	3.2	3.7



N: Marrett Street (Airport Road)
 E/W: Massachusetts Avenue (Route 2A)
 City, State: Lexington, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 D
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Marrett Street (Airport Road) From North			Massachusetts Avenue (Route 2A) From East			Massachusetts Avenue (Route 2A) From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
06:00 AM	0	0	0	0	99	0	48	0	0	147
06:15 AM	1	0	0	0	116	0	78	2	0	197
06:30 AM	0	1	0	0	150	0	113	0	0	264
06:45 AM	0	1	0	1	162	0	137	0	0	301
Total	1	2	0	1	527	0	376	2	0	909
07:00 AM	0	0	0	0	207	0	147	0	0	354
07:15 AM	2	0	0	0	177	0	180	1	0	360
07:30 AM	1	0	0	2	200	0	200	0	0	403
07:45 AM	0	0	0	1	218	0	219	0	0	438
Total	3	0	0	3	802	0	746	1	0	1555
08:00 AM	0	1	0	0	166	0	222	0	0	389
08:15 AM	0	0	0	0	177	0	237	0	0	414
08:30 AM	0	0	0	0	168	0	246	0	0	414
08:45 AM	0	1	0	0	186	0	235	3	0	425
Total	0	2	0	0	697	0	940	3	0	1642
Grand Total	4	4	0	4	2026	0	2062	6	0	4106
Apprch %	50	50	0	0.2	99.8	0	99.7	0.3	0	
Total %	0.1	0.1	0	0.1	49.3	0	50.2	0.1	0	
Cars	4	4	0	4	1944	0	2007	6	0	3969
% Cars	100	100	0	100	96	0	97.3	100	0	96.7
Heavy Vehicles	0	0	0	0	82	0	55	0	0	137
% Heavy Vehicles	0	0	0	0	4	0	2.7	0	0	3.3

	Marrett Street (Airport Road) From North				Massachusetts Avenue (Route 2A) From East				Massachusetts Avenue (Route 2A) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:45 AM													
07:45 AM	0	0	0	0	1	218	0	219	219	0	0	219	438
08:00 AM	0	1	0	1	0	166	0	166	222	0	0	222	389
08:15 AM	0	0	0	0	0	177	0	177	237	0	0	237	414
08:30 AM	0	0	0	0	0	168	0	168	246	0	0	246	414
Total Volume	0	1	0	1	1	729	0	730	924	0	0	924	1655
% App. Total	0	100	0		0.1	99.9	0		100	0	0		
PHF	.000	.250	.000	.250	.250	.836	.000	.833	.939	.000	.000	.939	.945
Cars	0	1	0	1	1	699	0	700	897	0	0	897	1598
% Cars	0	100	0	100	100	95.9	0	95.9	97.1	0	0	97.1	96.6
Heavy Vehicles	0	0	0	0	0	30	0	30	27	0	0	27	57
% Heavy Vehicles	0	0	0	0	0	4.1	0	4.1	2.9	0	0	2.9	3.4



PRECISION
D A T A
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N: Marrett Street (Airport Road)
E/W: Massachusetts Avenue (Route 2A)
City, State: Lexington, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 D
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars

	Marrett Street (Airport Road) From North			Massachusetts Avenue (Route 2A) From East			Massachusetts Avenue (Route 2A) From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
06:00 AM	0	0	0	0	93	0	46	0	0	139
06:15 AM	1	0	0	0	111	0	76	2	0	190
06:30 AM	0	1	0	0	147	0	110	0	0	258
06:45 AM	0	1	0	1	152	0	129	0	0	283
Total	1	2	0	1	503	0	361	2	0	870
07:00 AM	0	0	0	0	200	0	146	0	0	346
07:15 AM	2	0	0	0	170	0	175	1	0	348
07:30 AM	1	0	0	2	190	0	198	0	0	391
07:45 AM	0	0	0	1	209	0	207	0	0	417
Total	3	0	0	3	769	0	726	1	0	1502
08:00 AM	0	1	0	0	161	0	219	0	0	381
08:15 AM	0	0	0	0	168	0	232	0	0	400
08:30 AM	0	0	0	0	161	0	239	0	0	400
08:45 AM	0	1	0	0	182	0	230	3	0	416
Total	0	2	0	0	672	0	920	3	0	1597
Grand Total	4	4	0	4	1944	0	2007	6	0	3969
Apprch %	50	50	0	0.2	99.8	0	99.7	0.3	0	
Total %	0.1	0.1	0	0.1	49	0	50.6	0.2	0	

	Marrett Street (Airport Road) From North				Massachusetts Avenue (Route 2A) From East				Massachusetts Avenue (Route 2A) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:45 AM													
07:45 AM	0	0	0	0	1	209	0	210	207	0	0	207	417
08:00 AM	0	1	0	1	0	161	0	161	219	0	0	219	381
08:15 AM	0	0	0	0	0	168	0	168	232	0	0	232	400
08:30 AM	0	0	0	0	0	161	0	161	239	0	0	239	400
Total Volume	0	1	0	1	1	699	0	700	897	0	0	897	1598
% App. Total	0	100	0		0.1	99.9	0		100	0	0		
PHF	.000	.250	.000	.250	.250	.836	.000	.833	.938	.000	.000	.938	.958



PRECISION
D A T A
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N: Marrett Street (Airport Road)
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City, State: Lexington, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 D
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

	Marrett Street (Airport Road) From North			Massachusetts Avenue (Route 2A) From East			Massachusetts Avenue (Route 2A) From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
06:00 AM	0	0	0	0	6	0	2	0	0	8
06:15 AM	0	0	0	0	5	0	2	0	0	7
06:30 AM	0	0	0	0	3	0	3	0	0	6
06:45 AM	0	0	0	0	10	0	8	0	0	18
Total	0	0	0	0	24	0	15	0	0	39
07:00 AM	0	0	0	0	7	0	1	0	0	8
07:15 AM	0	0	0	0	7	0	5	0	0	12
07:30 AM	0	0	0	0	10	0	2	0	0	12
07:45 AM	0	0	0	0	9	0	12	0	0	21
Total	0	0	0	0	33	0	20	0	0	53
08:00 AM	0	0	0	0	5	0	3	0	0	8
08:15 AM	0	0	0	0	9	0	5	0	0	14
08:30 AM	0	0	0	0	7	0	7	0	0	14
08:45 AM	0	0	0	0	4	0	5	0	0	9
Total	0	0	0	0	25	0	20	0	0	45
Grand Total	0	0	0	0	82	0	55	0	0	137
Apprch %	0	0	0	0	100	0	100	0	0	
Total %	0	0	0	0	59.9	0	40.1	0	0	

	Marrett Street (Airport Road) From North				Massachusetts Avenue (Route 2A) From East				Massachusetts Avenue (Route 2A) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:45 AM													
07:45 AM	0	0	0	0	0	9	0	9	12	0	0	12	21
08:00 AM	0	0	0	0	0	5	0	5	3	0	0	3	8
08:15 AM	0	0	0	0	0	9	0	9	5	0	0	5	14
08:30 AM	0	0	0	0	0	7	0	7	7	0	0	7	14
Total Volume	0	0	0	0	0	30	0	30	27	0	0	27	57
% App. Total	0	0	0		0	100	0		100	0	0		
PHF	.000	.000	.000	.000	.000	.833	.000	.833	.563	.000	.000	.563	.679



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

N: Marrett Street (Airport Road)
E/W: Massachusetts Avenue (Route 2A)
City, State: Lexington, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 D
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

	Marrett Street (Airport Road) From North			Massachusetts Avenue (Route 2A) From East			Massachusetts Avenue (Route 2A) From West			
Start Time	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	Int. Total
06:00 AM	0	0	0	0	0	0	1	0	0	1
06:15 AM	0	0	0	0	0	0	0	0	0	0
06:30 AM	0	0	0	0	0	0	0	0	0	0
06:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	1	0	0	1
07:00 AM	0	0	0	0	1	0	0	0	0	1
07:15 AM	0	0	0	0	0	0	1	0	0	1
07:30 AM	0	0	0	0	0	0	7	0	0	7
07:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	1	0	8	0	0	9
08:00 AM	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	1	0	0	0	0	1
08:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	1	0	0	0	0	1
Grand Total	0	0	0	0	2	0	9	0	0	11
Apprch %	0	0	0	0	100	0	100	0	0	
Total %	0	0	0	0	18.2	0	81.8	0	0	

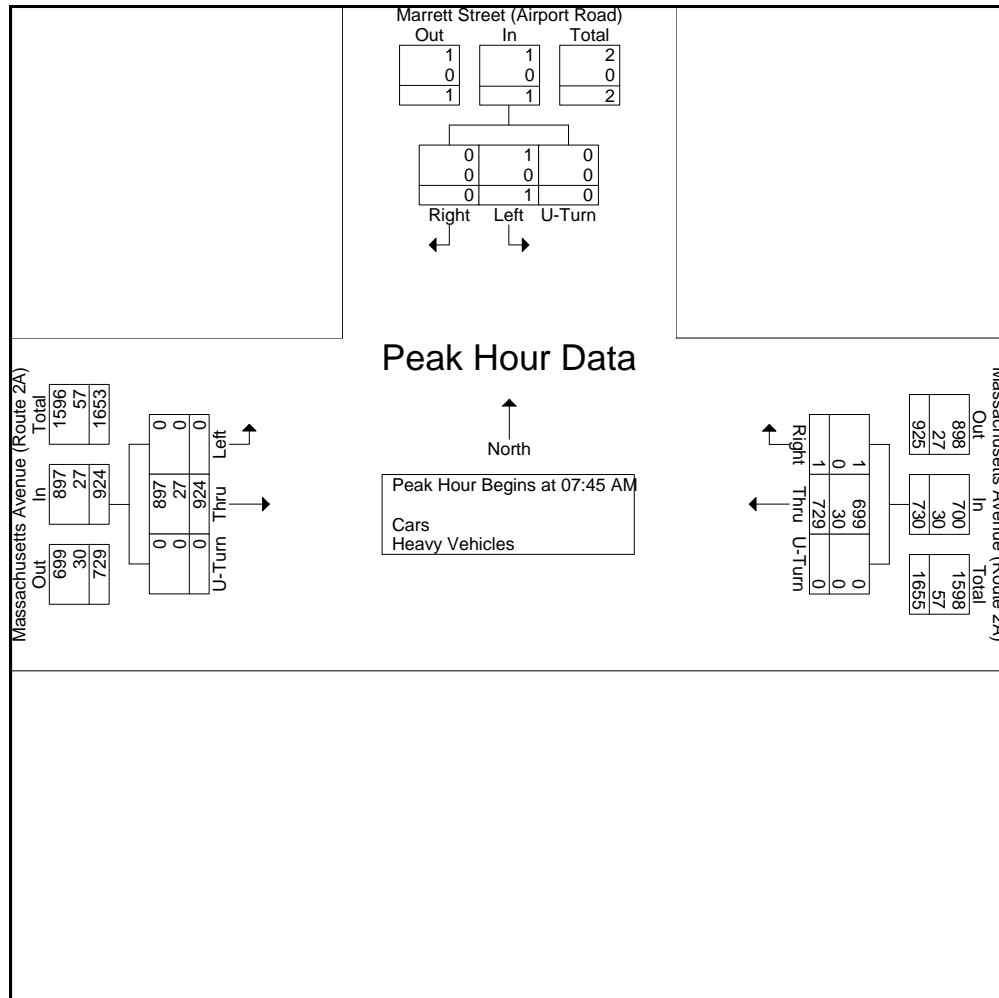
	Marrett Street (Airport Road) From North				Massachusetts Avenue (Route 2A) From East				Massachusetts Avenue (Route 2A) From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 06:45 AM													
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
07:00 AM	0	0	0	0	0	1	0	1	0	0	0	0	1
07:15 AM	0	0	0	0	0	0	0	0	1	0	0	1	1
07:30 AM	0	0	0	0	0	0	0	0	7	0	0	7	7
Total Volume	0	0	0	0	0	1	0	1	8	0	0	8	9
% App. Total	0	0	0		0	100	0		100	0	0		
PHF	.000	.000	.000	.000	.000	.250	.000	.250	.286	.000	.000	.286	.321

N: Marrett Street (Airport Road)
 E/W: Massachusetts Avenue (Route 2A)
 City, State: Lexington, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 D
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

	Marrett Street (Airport Road)				Massachusetts Avenue (Route 2A)				Massachusetts Avenue (Route 2A)				
	From North				From East				From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Left	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:45 AM													
07:45 AM	0	0	0	0	1	218	0	219	219	0	0	219	438
08:00 AM	0	1	0	1	0	166	0	166	222	0	0	222	389
08:15 AM	0	0	0	0	0	177	0	177	237	0	0	237	414
08:30 AM	0	0	0	0	0	168	0	168	246	0	0	246	414
Total Volume	0	1	0	1	1	729	0	730	924	0	0	924	1655
% App. Total	0	100	0		0.1	99.9	0		100	0	0		
PHF	.000	.250	.000	.250	.250	.836	.000	.833	.939	.000	.000	.939	.945
Cars	0	1	0	1	1	699	0	700	897	0	0	897	1598
% Cars	0	100	0	100	100	95.9	0	95.9	97.1	0	0	97.1	96.6
Heavy Vehicles	0	0	0	0	0	30	0	30	27	0	0	27	57
% Heavy Vehicles	0	0	0	0	0	4.1	0	4.1	2.9	0	0	2.9	3.4





PRECISION
D A T A
INDUSTRIES, LLC

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N/S: Airport/ Hanscom Drive
E/W: Vandenburg Gate/ Old Bedford Road
City, State: Lincoln, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 E
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Hanscom Drive (Airport) From North				Old Bedford Road (Vandenburg Gate) From East				Hanscom Drive From South				Old Bedford Road From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
06:00 AM	0	3	0	0	1	0	10	0	83	15	9	0	7	8	5	0	141
06:15 AM	0	2	0	0	0	1	17	0	70	20	12	0	7	17	2	0	148
06:30 AM	1	5	0	0	0	2	22	0	100	19	30	1	19	23	3	0	225
06:45 AM	1	4	1	0	1	2	28	0	114	13	28	0	6	41	5	0	244
Total	2	14	1	0	2	5	77	0	367	67	79	1	39	89	15	0	758
07:00 AM	1	2	1	0	0	3	28	0	108	18	41	0	26	35	10	0	273
07:15 AM	1	4	0	0	0	4	22	0	97	27	34	0	24	50	14	0	277
07:30 AM	1	5	0	0	0	4	34	0	121	12	31	1	30	68	5	0	312
07:45 AM	1	7	0	0	0	8	30	0	110	14	31	0	36	63	4	0	304
Total	4	18	1	0	0	19	114	0	436	71	137	1	116	216	33	0	1166
08:00 AM	0	4	0	0	1	7	28	0	88	8	26	0	27	60	4	0	253
08:15 AM	0	7	1	0	0	3	15	0	93	13	47	0	31	63	3	1	277
08:30 AM	0	3	0	0	0	4	19	0	86	15	43	1	22	50	3	0	246
08:45 AM	1	11	3	0	0	3	21	0	88	9	48	0	25	42	5	0	256
Total	1	25	4	0	1	17	83	0	355	45	164	1	105	215	15	1	1032
Grand Total	7	57	6	0	3	41	274	0	1158	183	380	3	260	520	63	1	2956
Apprch %	10	81.4	8.6	0	0.9	12.9	86.2	0	67.2	10.6	22	0.2	30.8	61.6	7.5	0.1	
Total %	0.2	1.9	0.2	0	0.1	1.4	9.3	0	39.2	6.2	12.9	0.1	8.8	17.6	2.1	0	
Cars	7	47	4	0	2	41	261	0	1125	173	371	3	255	515	63	1	2868
% Cars	100	82.5	66.7	0	66.7	100	95.3	0	97.2	94.5	97.6	100	98.1	99	100	100	97
Heavy Vehicles	0	10	2	0	1	0	13	0	33	10	9	0	5	5	0	0	88
% Heavy Vehicles	0	17.5	33.3	0	33.3	0	4.7	0	2.8	5.5	2.4	0	1.9	1	0	0	3

	Hanscom Drive (Airport) From North					Old Bedford Road (Vandenburg Gate) From East					Hanscom Drive From South					Old Bedford Road From West					Int. Total
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	1	2	1	0	4	0	3	28	0	31	108	18	41	0	167	26	35	10	0	71	273
07:15 AM	1	4	0	0	5	0	4	22	0	26	97	27	34	0	158	24	50	14	0	88	277
07:30 AM	1	5	0	0	6	0	4	34	0	38	121	12	31	1	165	30	68	5	0	103	312
07:45 AM	1	7	0	0	8	0	8	30	0	38	110	14	31	0	155	36	63	4	0	103	304
Total Volume	4	18	1	0	23	0	19	114	0	133	436	71	137	1	645	116	216	33	0	365	1166
% App. Total	17.4	78.3	4.3	0		0	14.3	85.7	0		67.6	11	21.2	0.2		31.8	59.2	9	0		
PHF	1.00	.643	.250	.000	.719	.000	.594	.838	.000	.875	.901	.657	.835	.250	.966	.806	.794	.589	.000	.886	.934
Cars	4	15	1	0	20	0	19	109	0	128	424	69	134	1	628	114	213	33	0	360	1136
% Cars	100	83.3	100	0	87.0	0	100	95.6	0	96.2	97.2	97.2	97.8	100	97.4	98.3	98.6	100	0	98.6	97.4
Heavy Vehicles	0	3	0	0	3	0	0	5	0	5	12	2	3	0	17	2	3	0	0	5	30
% Heavy Vehicles	0	16.7	0	0	13.0	0	0	4.4	0	3.8	2.8	2.8	2.2	0	2.6	1.7	1.4	0	0	1.4	2.6



PRECISION
D A T A
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N/S: Airport/ Hanscom Drive
E/W: Vandenburg Gate/ Old Bedford Road
City, State: Lincoln, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 E
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars

	Hanscom Drive (Airport) From North				Old Bedford Road (Vandenburg Gate) From East				Hanscom Drive From South				Old Bedford Road From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
06:00 AM	0	2	0	0	1	0	9	0	79	14	9	0	7	7	5	0	133
06:15 AM	0	2	0	0	0	1	16	0	68	20	12	0	7	17	2	0	145
06:30 AM	1	5	0	0	0	2	22	0	98	18	29	1	18	23	3	0	220
06:45 AM	1	3	1	0	1	2	26	0	109	12	27	0	6	40	5	0	233
Total	2	12	1	0	2	5	73	0	354	64	77	1	38	87	15	0	731
07:00 AM	1	1	1	0	0	3	28	0	104	17	39	0	25	33	10	0	262
07:15 AM	1	4	0	0	0	4	21	0	94	27	34	0	24	49	14	0	272
07:30 AM	1	4	0	0	0	4	34	0	118	11	30	1	29	68	5	0	305
07:45 AM	1	6	0	0	0	8	26	0	108	14	31	0	36	63	4	0	297
Total	4	15	1	0	0	19	109	0	424	69	134	1	114	213	33	0	1136
08:00 AM	0	4	0	0	0	7	27	0	86	7	24	0	27	60	4	0	246
08:15 AM	0	4	1	0	0	3	14	0	90	12	45	0	30	63	3	1	266
08:30 AM	0	3	0	0	0	4	17	0	83	13	43	1	22	50	3	0	239
08:45 AM	1	9	1	0	0	3	21	0	88	8	48	0	24	42	5	0	250
Total	1	20	2	0	0	17	79	0	347	40	160	1	103	215	15	1	1001
Grand Total	7	47	4	0	2	41	261	0	1125	173	371	3	255	515	63	1	2868
Apprch %	12.1	81	6.9	0	0.7	13.5	85.9	0	67.3	10.3	22.2	0.2	30.6	61.8	7.6	0.1	
Total %	0.2	1.6	0.1	0	0.1	1.4	9.1	0	39.2	6	12.9	0.1	8.9	18	2.2	0	

	Hanscom Drive (Airport) From North					Old Bedford Road (Vandenburg Gate) From East					Hanscom Drive From South					Old Bedford Road From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	1	1	1	0	3	0	3	28	0	31	104	17	39	0	160	25	33	10	0	68	262
07:15 AM	1	4	0	0	5	0	4	21	0	25	94	27	34	0	155	24	49	14	0	87	272
07:30 AM	1	4	0	0	5	0	4	34	0	38	118	11	30	1	160	29	68	5	0	102	305
07:45 AM	1	6	0	0	7	0	8	26	0	34	108	14	31	0	153	36	63	4	0	103	297
Total Volume	4	15	1	0	20	0	19	109	0	128	424	69	134	1	628	114	213	33	0	360	1136
% App. Total	20	75	5	0		0	14.8	85.2	0		67.5	11	21.3	0.2		31.7	59.2	9.2	0		
PHF	1.00	.625	.250	.000	.714	.000	.594	.801	.000	.842	.898	.639	.859	.250	.981	.792	.783	.589	.000	.874	.931



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
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N/S: Airport/ Hanscom Drive
E/W: Vandenburg Gate/ Old Bedford Road
City, State: Lincoln, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 E
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

	Hanscom Drive (Airport) From North				Old Bedford Road (Vandenburg Gate) From East				Hanscom Drive From South				Old Bedford Road From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
06:00 AM	0	1	0	0	0	0	1	0	4	1	0	0	0	1	0	0	8
06:15 AM	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	3
06:30 AM	0	0	0	0	0	0	0	0	2	1	1	0	1	0	0	0	5
06:45 AM	0	1	0	0	0	0	2	0	5	1	1	0	0	1	0	0	11
Total	0	2	0	0	0	0	4	0	13	3	2	0	1	2	0	0	27
07:00 AM	0	1	0	0	0	0	0	0	4	1	2	0	1	2	0	0	11
07:15 AM	0	0	0	0	0	0	1	0	3	0	0	0	0	1	0	0	5
07:30 AM	0	1	0	0	0	0	0	0	3	1	1	0	1	0	0	0	7
07:45 AM	0	1	0	0	0	0	4	0	2	0	0	0	0	0	0	0	7
Total	0	3	0	0	0	0	5	0	12	2	3	0	2	3	0	0	30
08:00 AM	0	0	0	0	1	0	1	0	2	1	2	0	0	0	0	0	7
08:15 AM	0	3	0	0	0	0	1	0	3	1	2	0	1	0	0	0	11
08:30 AM	0	0	0	0	0	0	2	0	3	2	0	0	0	0	0	0	7
08:45 AM	0	2	2	0	0	0	0	0	0	1	0	0	1	0	0	0	6
Total	0	5	2	0	1	0	4	0	8	5	4	0	2	0	0	0	31
Grand Total	0	10	2	0	1	0	13	0	33	10	9	0	5	5	0	0	88
Apprch %	0	83.3	16.7	0	7.1	0	92.9	0	63.5	19.2	17.3	0	50	50	0	0	
Total %	0	11.4	2.3	0	1.1	0	14.8	0	37.5	11.4	10.2	0	5.7	5.7	0	0	

	Hanscom Drive (Airport) From North					Old Bedford Road (Vandenburg Gate) From East					Hanscom Drive From South					Old Bedford Road From West					Int. Total
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 06:45 AM																					
06:45 AM	0	1	0	0	1	0	0	2	0	2	5	1	1	0	7	0	1	0	0	1	11
07:00 AM	0	1	0	0	1	0	0	0	0	0	4	1	2	0	7	1	2	0	0	3	11
07:15 AM	0	0	0	0	0	0	0	1	0	1	3	0	0	0	3	0	1	0	0	1	5
07:30 AM	0	1	0	0	1	0	0	0	0	0	3	1	1	0	5	1	0	0	0	1	7
Total Volume	0	3	0	0	3	0	0	3	0	3	15	3	4	0	22	2	4	0	0	6	34
% App. Total	0	100	0	0		0	0	100	0		68.2	13.6	18.2	0		33.3	66.7	0	0		
PHF	.000	.750	.000	.000	.750	.000	.000	.375	.000	.375	.750	.750	.500	.000	.786	.500	.500	.000	.000	.500	.773



PRECISION
DATA
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File Name : 123082 E
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

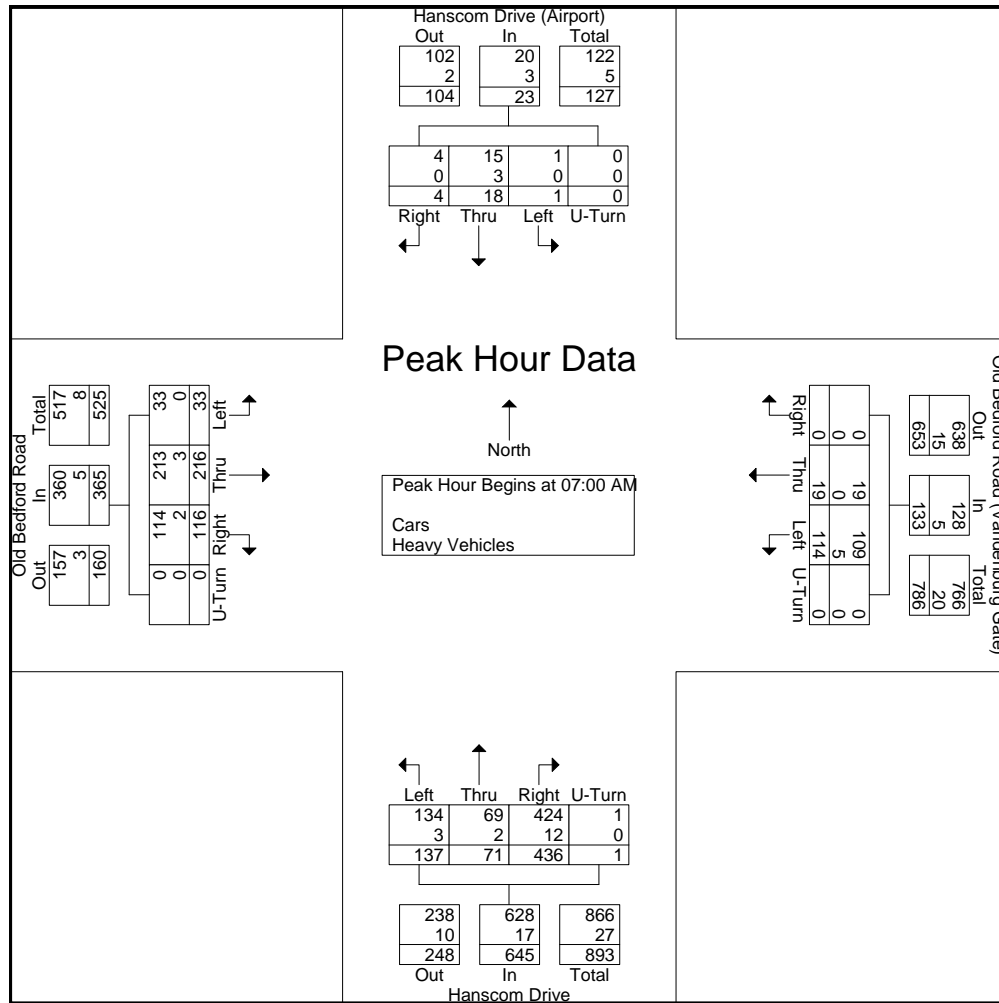
[illegible][illegible]

N/S: Airport/ Hanscom Drive
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 City, State: Lincoln, MA
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File Name : 123082 E
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

	Hanscom Drive (Airport) From North					Old Bedford Road (Vandenburg Gate) From East					Hanscom Drive From South					Old Bedford Road From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00 AM																					
07:00 AM	1	2	1	0	4	0	3	28	0	31	108	18	41	0	167	26	35	10	0	71	273
07:15 AM	1	4	0	0	5	0	4	22	0	26	97	27	34	0	158	24	50	14	0	88	277
07:30 AM	1	5	0	0	6	0	4	34	0	38	121	12	31	1	165	30	68	5	0	103	312
07:45 AM	1	7	0	0	8	0	8	30	0	38	110	14	31	0	155	36	63	4	0	103	304
Total Volume	4	18	1	0	23	0	19	114	0	133	436	71	137	1	645	116	216	33	0	365	1166
% App. Total	17.4	78.3	4.3	0		0	14.3	85.7	0		67.6	11	21.2	0.2		31.8	59.2	9	0		
PHF	1.00	.643	.250	.000	.719	.000	.594	.838	.000	.875	.901	.657	.835	.250	.966	.806	.794	.589	.000	.886	.934
Cars	4	15	1	0	20	0	19	109	0	128	424	69	134	1	628	114	213	33	0	360	1136
% Cars	100	83.3	100	0	87.0	0	100	95.6	0	96.2	97.2	97.2	97.8	100	97.4	98.3	98.6	100	0	98.6	97.4
Heavy Vehicles	0	3	0	0	3	0	0	5	0	5	12	2	3	0	17	2	3	0	0	5	30
% Heavy Vehicles	0	16.7	0	0	13.0	0	0	4.4	0	3.8	2.8	2.8	2.2	0	2.6	1.7	1.4	0	0	1.4	2.6





PRECISION
D A T A
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N: Hanscom Drive
E/W: North Great Road (Route 2A)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 F
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

Start Time	Hanscom Drive From North			North Great Road (Route 2A) From East			North Great Road (Route 2A) From West			Int. Total
	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	
06:00 AM	5	11	0	63	36	0	37	41	0	193
06:15 AM	4	24	0	72	46	0	63	35	0	244
06:30 AM	21	22	0	98	45	0	97	51	0	334
06:45 AM	22	16	0	112	55	0	115	60	0	380
Total	52	73	0	345	182	0	312	187	0	1151
07:00 AM	21	23	0	116	89	0	136	54	0	439
07:15 AM	32	23	0	105	74	0	177	50	0	461
07:30 AM	36	23	0	95	97	0	189	74	0	514
07:45 AM	41	37	0	98	120	0	181	73	0	550
Total	130	106	0	414	380	0	683	251	0	1964
08:00 AM	37	27	1	81	92	0	209	58	0	505
08:15 AM	23	26	0	90	95	0	216	66	0	516
08:30 AM	18	24	0	63	101	0	220	80	0	506
08:45 AM	32	26	0	84	102	0	191	58	0	493
Total	110	103	1	318	390	0	836	262	0	2020
Grand Total	292	282	1	1077	952	0	1831	700	0	5135
Apprch %	50.8	49	0.2	53.1	46.9	0	72.3	27.7	0	
Total %	5.7	5.5	0	21	18.5	0	35.7	13.6	0	
Cars	287	262	1	1029	917	0	1796	694	0	4986
% Cars	98.3	92.9	100	95.5	96.3	0	98.1	99.1	0	97.1
Heavy Vehicles	5	20	0	48	35	0	35	6	0	149
% Heavy Vehicles	1.7	7.1	0	4.5	3.7	0	1.9	0.9	0	2.9

	Hanscom Drive From North				North Great Road (Route 2A) From East				North Great Road (Route 2A) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:30 AM													
07:30 AM	36	23	0	59	95	97	0	192	189	74	0	263	514
07:45 AM	41	37	0	78	98	120	0	218	181	73	0	254	550
08:00 AM	37	27	1	65	81	92	0	173	209	58	0	267	505
08:15 AM	23	26	0	49	90	95	0	185	216	66	0	282	516
Total Volume	137	113	1	251	364	404	0	768	795	271	0	1066	2085
% App. Total	54.6	45	0.4		47.4	52.6	0		74.6	25.4	0		
PHF	.835	.764	.250	.804	.929	.842	.000	.881	.920	.916	.000	.945	.948
Cars	134	106	1	241	346	387	0	733	782	268	0	1050	2024
% Cars	97.8	93.8	100	96.0	95.1	95.8	0	95.4	98.4	98.9	0	98.5	97.1
Heavy Vehicles	3	7	0	10	18	17	0	35	13	3	0	16	61
% Heavy Vehicles	2.2	6.2	0	4.0	4.9	4.2	0	4.6	1.6	1.1	0	1.5	2.9



PRECISION
D A T A
INDUSTRIES, LLC

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Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

N: Hanscom Drive
E/W: North Great Road (Route 2A)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 F
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars

Start Time	Hanscom Drive From North			North Great Road (Route 2A) From East			North Great Road (Route 2A) From West			Int. Total
	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	
06:00 AM	4	10	0	59	35	0	36	41	0	185
06:15 AM	4	24	0	70	43	0	61	35	0	237
06:30 AM	21	20	0	95	45	0	96	50	0	327
06:45 AM	22	13	0	105	53	0	111	60	0	364
Total	51	67	0	329	176	0	304	186	0	1113
07:00 AM	21	21	0	110	86	0	134	53	0	425
07:15 AM	32	22	0	102	71	0	173	50	0	450
07:30 AM	35	23	0	90	93	0	183	72	0	496
07:45 AM	40	33	0	94	114	0	179	73	0	533
Total	128	99	0	396	364	0	669	248	0	1904
08:00 AM	37	27	1	77	92	0	208	58	0	500
08:15 AM	22	23	0	85	88	0	212	65	0	495
08:30 AM	18	22	0	59	99	0	214	79	0	491
08:45 AM	31	24	0	83	98	0	189	58	0	483
Total	108	96	1	304	377	0	823	260	0	1969
Grand Total	287	262	1	1029	917	0	1796	694	0	4986
Apprch %	52.2	47.6	0.2	52.9	47.1	0	72.1	27.9	0	
Total %	5.8	5.3	0	20.6	18.4	0	36	13.9	0	

	Hanscom Drive From North				North Great Road (Route 2A) From East				North Great Road (Route 2A) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:30 AM													
07:30 AM	35	23	0	58	90	93	0	183	183	72	0	255	496
07:45 AM	40	33	0	73	94	114	0	208	179	73	0	252	533
08:00 AM	37	27	1	65	77	92	0	169	208	58	0	266	500
08:15 AM	22	23	0	45	85	88	0	173	212	65	0	277	495
Total Volume	134	106	1	241	346	387	0	733	782	268	0	1050	2024
% App. Total	55.6	44	0.4		47.2	52.8	0		74.5	25.5	0		
PHF	.838	.803	.250	.825	.920	.849	.000	.881	.922	.918	.000	.948	.949



PRECISION
D A T A
INDUSTRIES, LLC

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N: Hanscom Drive
E/W: North Great Road (Route 2A)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 F
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

Start Time	Hanscom Drive From North			North Great Road (Route 2A) From East			North Great Road (Route 2A) From West			Int. Total
	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	
06:00 AM	1	1	0	4	1	0	1	0	0	8
06:15 AM	0	0	0	2	3	0	2	0	0	7
06:30 AM	0	2	0	3	0	0	1	1	0	7
06:45 AM	0	3	0	7	2	0	4	0	0	16
Total	1	6	0	16	6	0	8	1	0	38
07:00 AM	0	2	0	6	3	0	2	1	0	14
07:15 AM	0	1	0	3	3	0	4	0	0	11
07:30 AM	1	0	0	5	4	0	6	2	0	18
07:45 AM	1	4	0	4	6	0	2	0	0	17
Total	2	7	0	18	16	0	14	3	0	60
08:00 AM	0	0	0	4	0	0	1	0	0	5
08:15 AM	1	3	0	5	7	0	4	1	0	21
08:30 AM	0	2	0	4	2	0	6	1	0	15
08:45 AM	1	2	0	1	4	0	2	0	0	10
Total	2	7	0	14	13	0	13	2	0	51
Grand Total	5	20	0	48	35	0	35	6	0	149
Apprch %	20	80	0	57.8	42.2	0	85.4	14.6	0	
Total %	3.4	13.4	0	32.2	23.5	0	23.5	4	0	

	Hanscom Drive From North				North Great Road (Route 2A) From East				North Great Road (Route 2A) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:30 AM													
07:30 AM	1	0	0	1	5	4	0	9	6	2	0	8	18
07:45 AM	1	4	0	5	4	6	0	10	2	0	0	2	17
08:00 AM	0	0	0	0	4	0	0	4	1	0	0	1	5
08:15 AM	1	3	0	4	5	7	0	12	4	1	0	5	21
Total Volume	3	7	0	10	18	17	0	35	13	3	0	16	61
% App. Total	30	70	0		51.4	48.6	0		81.2	18.8	0		
PHF	.750	.438	.000	.500	.900	.607	.000	.729	.542	.375	.000	.500	.726



PRECISION
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N: Hanscom Drive
E/W: North Great Road (Route 2A)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 F
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

Start Time	Hanscom Drive From North			North Great Road (Route 2A) From East			North Great Road (Route 2A) From West			Int. Total
	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	
06:00 AM	0	0	0	0	0	0	0	1	0	1
06:15 AM	0	0	0	0	0	0	0	0	0	0
06:30 AM	0	0	0	0	0	0	0	0	0	0
06:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	1	0	1
07:00 AM	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	1	0	0	1
08:30 AM	0	0	0	0	1	0	1	0	0	2
08:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	1	0	2	0	0	3
Grand Total	0	0	0	0	1	0	2	1	0	4
Apprch %	0	0	0	0	100	0	66.7	33.3	0	
Total %	0	0	0	0	25	0	50	25	0	

	Hanscom Drive From North				North Great Road (Route 2A) From East				North Great Road (Route 2A) From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:45 AM													
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	1	0	0	1	1
08:30 AM	0	0	0	0	0	1	0	1	1	0	0	1	2
Total Volume	0	0	0	0	0	1	0	1	2	0	0	2	3
% App. Total	0	0	0		0	100	0		100	0	0		
PHF	.000	.000	.000	.000	.000	.250	.000	.250	.500	.000	.000	.500	.375



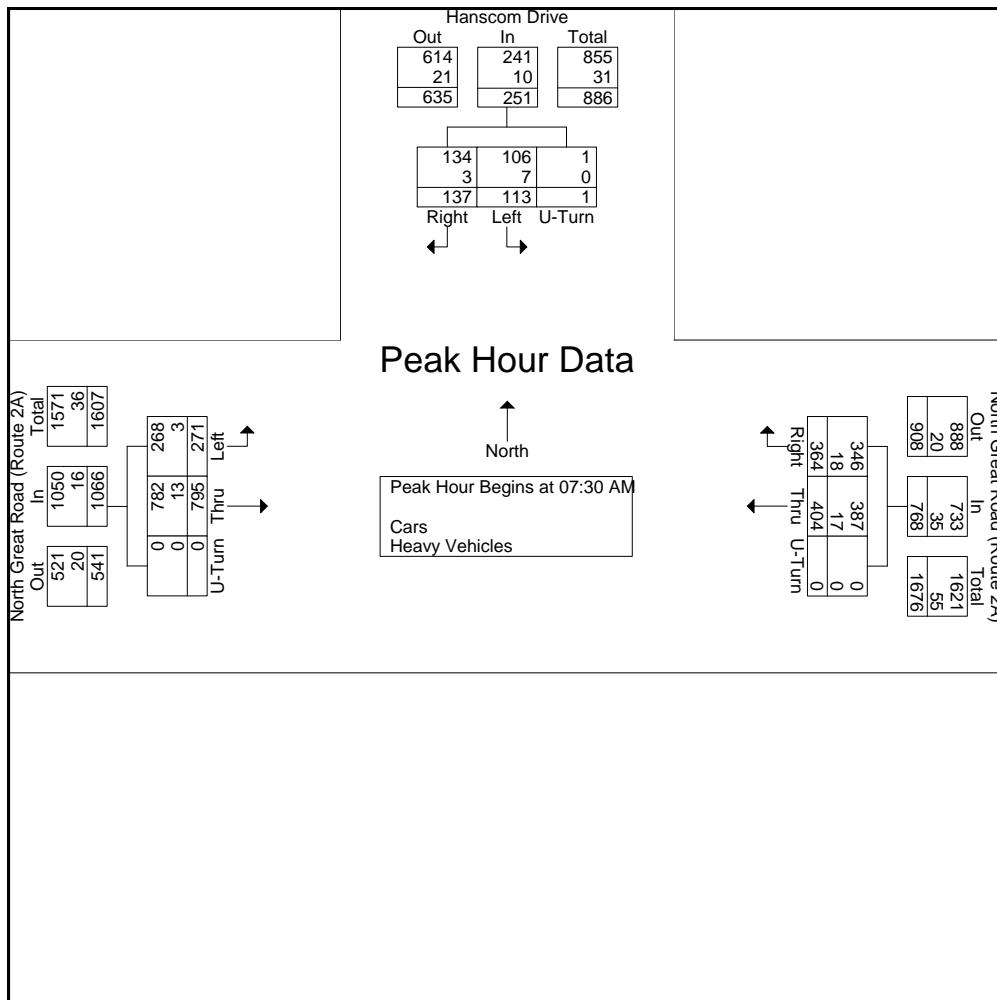
PRECISION
D A T A
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N: Hanscom Drive
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City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 F
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	Hanscom Drive From North				North Great Road (Route 2A) From East				North Great Road (Route 2A) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:30 AM													
07:30 AM	36	23	0	59	95	97	0	192	189	74	0	263	514
07:45 AM	41	37	0	78	98	120	0	218	181	73	0	254	550
08:00 AM	37	27	1	65	81	92	0	173	209	58	0	267	505
08:15 AM	23	26	0	49	90	95	0	185	216	66	0	282	516
Total Volume	137	113	1	251	364	404	0	768	795	271	0	1066	2085
% App. Total	54.6	45	0.4		47.4	52.6	0		74.6	25.4	0		
PHF	.835	.764	.250	.804	.929	.842	.000	.881	.920	.916	.000	.945	.948
Cars	134	106	1	241	346	387	0	733	782	268	0	1050	2024
% Cars	97.8	93.8	100	96.0	95.1	95.8	0	95.4	98.4	98.9	0	98.5	97.1
Heavy Vehicles	3	7	0	10	18	17	0	35	13	3	0	16	61
% Heavy Vehicles	2.2	6.2	0	4.0	4.9	4.2	0	4.6	1.6	1.1	0	1.5	2.9





PRECISION
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S: Bedford Road
E/W: North Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 G
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	North Great Road (Route 2A) From East			Bedford Road From South			North Great Road (Route 2A) From West			
Start Time	Thru	Left	U-Turn	Right	Left	U-Turn	Right	Thru	U-Turn	Int. Total
06:00 AM	35	4	0	4	0	0	3	70	0	116
06:15 AM	43	7	1	16	0	0	14	85	0	166
06:30 AM	47	21	0	14	1	0	15	129	0	227
06:45 AM	67	11	0	34	0	0	45	147	0	304
Total	192	43	1	68	1	0	77	431	0	813
07:00 AM	86	19	0	28	0	0	48	165	0	346
07:15 AM	83	26	0	28	3	0	45	191	0	376
07:30 AM	95	33	1	54	1	0	58	212	0	454
07:45 AM	113	49	0	59	5	0	51	197	0	474
Total	377	127	1	169	9	0	202	765	0	1650
08:00 AM	84	42	0	50	6	0	43	225	0	450
08:15 AM	86	30	0	61	2	0	46	221	0	446
08:30 AM	88	28	0	64	4	0	40	235	0	459
08:45 AM	111	28	1	61	5	0	40	192	0	438
Total	369	128	1	236	17	0	169	873	0	1793
Grand Total	938	298	3	473	27	0	448	2069	0	4256
Apprch %	75.7	24.1	0.2	94.6	5.4	0	17.8	82.2	0	
Total %	22	7	0.1	11.1	0.6	0	10.5	48.6	0	
Cars	901	293	3	470	27	0	447	2029	0	4170
% Cars	96.1	98.3	100	99.4	100	0	99.8	98.1	0	98
Heavy Vehicles	37	5	0	3	0	0	1	40	0	86
% Heavy Vehicles	3.9	1.7	0	0.6	0	0	0.2	1.9	0	2

	North Great Road (Route 2A) From East				Bedford Road From South				North Great Road (Route 2A) From West				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:45 AM													
07:45 AM	113	49	0	162	59	5	0	64	51	197	0	248	474
08:00 AM	84	42	0	126	50	6	0	56	43	225	0	268	450
08:15 AM	86	30	0	116	61	2	0	63	46	221	0	267	446
08:30 AM	88	28	0	116	64	4	0	68	40	235	0	275	459
Total Volume	371	149	0	520	234	17	0	251	180	878	0	1058	1829
% App. Total	71.3	28.7	0		93.2	6.8	0		17	83	0		
PHF	.821	.760	.000	.802	.914	.708	.000	.923	.882	.934	.000	.962	.965
Cars	355	148	0	503	234	17	0	251	179	860	0	1039	1793
% Cars	95.7	99.3	0	96.7	100	100	0	100	99.4	97.9	0	98.2	98.0
Heavy Vehicles	16	1	0	17	0	0	0	0	1	18	0	19	36
% Heavy Vehicles	4.3	0.7	0	3.3	0	0	0	0	0.6	2.1	0	1.8	2.0



PRECISION
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S: Bedford Road
E/W: North Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 G
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars

Start Time	North Great Road (Route 2A) From East			Bedford Road From South			North Great Road (Route 2A) From West			Int. Total
	Thru	Left	U-Turn	Right	Left	U-Turn	Right	Thru	U-Turn	
06:00 AM	33	3	0	4	0	0	3	69	0	112
06:15 AM	41	7	1	16	0	0	14	84	0	163
06:30 AM	47	21	0	14	1	0	15	126	0	224
06:45 AM	66	11	0	34	0	0	45	143	0	299
Total	187	42	1	68	1	0	77	422	0	798
07:00 AM	82	19	0	28	0	0	48	162	0	339
07:15 AM	80	25	0	28	3	0	45	188	0	369
07:30 AM	91	31	1	51	1	0	58	207	0	440
07:45 AM	107	49	0	59	5	0	50	195	0	465
Total	360	124	1	166	9	0	201	752	0	1613
08:00 AM	83	42	0	50	6	0	43	222	0	446
08:15 AM	79	29	0	61	2	0	46	215	0	432
08:30 AM	86	28	0	64	4	0	40	228	0	450
08:45 AM	106	28	1	61	5	0	40	190	0	431
Total	354	127	1	236	17	0	169	855	0	1759
Grand Total	901	293	3	470	27	0	447	2029	0	4170
Apprch %	75.3	24.5	0.3	94.6	5.4	0	18.1	81.9	0	
Total %	21.6	7	0.1	11.3	0.6	0	10.7	48.7	0	

	North Great Road (Route 2A) From East				Bedford Road From South				North Great Road (Route 2A) From West				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:45 AM													
07:45 AM	107	49	0	156	59	5	0	64	50	195	0	245	465
08:00 AM	83	42	0	125	50	6	0	56	43	222	0	265	446
08:15 AM	79	29	0	108	61	2	0	63	46	215	0	261	432
08:30 AM	86	28	0	114	64	4	0	68	40	228	0	268	450
Total Volume	355	148	0	503	234	17	0	251	179	860	0	1039	1793
% App. Total	70.6	29.4	0		93.2	6.8	0		17.2	82.8	0		
PHF	.829	.755	.000	.806	.914	.708	.000	.923	.895	.943	.000	.969	.964



PRECISION
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S: Bedford Road
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City, State: Lincoln, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 G
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

	North Great Road (Route 2A) From East			Bedford Road From South			North Great Road (Route 2A) From West			
Start Time	Thru	Left	U-Turn	Right	Left	U-Turn	Right	Thru	U-Turn	Int. Total
06:00 AM	2	1	0	0	0	0	0	1	0	4
06:15 AM	2	0	0	0	0	0	0	1	0	3
06:30 AM	0	0	0	0	0	0	0	3	0	3
06:45 AM	1	0	0	0	0	0	0	4	0	5
Total	5	1	0	0	0	0	0	9	0	15
07:00 AM	4	0	0	0	0	0	0	3	0	7
07:15 AM	3	1	0	0	0	0	0	3	0	7
07:30 AM	4	2	0	3	0	0	0	5	0	14
07:45 AM	6	0	0	0	0	0	1	2	0	9
Total	17	3	0	3	0	0	1	13	0	37
08:00 AM	1	0	0	0	0	0	0	3	0	4
08:15 AM	7	1	0	0	0	0	0	6	0	14
08:30 AM	2	0	0	0	0	0	0	7	0	9
08:45 AM	5	0	0	0	0	0	0	2	0	7
Total	15	1	0	0	0	0	0	18	0	34
Grand Total	37	5	0	3	0	0	1	40	0	86
Apprch %	88.1	11.9	0	100	0	0	2.4	97.6	0	
Total %	43	5.8	0	3.5	0	0	1.2	46.5	0	

	North Great Road (Route 2A) From East				Bedford Road From South				North Great Road (Route 2A) From West				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:30 AM													
07:30 AM	4	2	0	6	3	0	0	3	0	5	0	5	14
07:45 AM	6	0	0	6	0	0	0	0	1	2	0	3	9
08:00 AM	1	0	0	1	0	0	0	0	0	3	0	3	4
08:15 AM	7	1	0	8	0	0	0	0	0	6	0	6	14
Total Volume	18	3	0	21	3	0	0	3	1	16	0	17	41
% App. Total	85.7	14.3	0		100	0	0		5.9	94.1	0		
PHF	.643	.375	.000	.656	.250	.000	.000	.250	.250	.667	.000	.708	.732



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
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S: Bedford Road
E/W: North Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 G
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

Start Time	North Great Road (Route 2A) From East			Bedford Road From South			North Great Road (Route 2A) From West			Int. Total
	Thru	Left	Peds	Right	Left	Peds	Right	Thru	Peds	
06:00 AM	0	0	0	1	0	0	0	1	0	2
06:15 AM	0	0	0	0	0	0	0	0	0	0
06:30 AM	0	0	0	0	0	0	0	0	0	0
06:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	1	0	0	0	1	0	2
07:00 AM	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	1	0	1
07:30 AM	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	1	0	1
08:00 AM	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0
08:30 AM	1	0	0	0	0	0	0	0	0	1
08:45 AM	0	0	0	0	0	0	0	0	0	0
Total	1	0	0	0	0	0	0	0	0	1
Grand Total	1	0	0	1	0	0	0	2	0	4
Apprch %	100	0	0	100	0	0	0	100	0	
Total %	25	0	0	25	0	0	0	50	0	

	North Great Road (Route 2A) From East				Bedford Road From South				North Great Road (Route 2A) From West				
Start Time	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 06:00 AM													
06:00 AM	0	0	0	0	1	0	0	1	0	1	0	1	2
06:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
06:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	1	0	0	1	0	1	0	1	2
% App. Total	0	0	0		100	0	0		0	100	0		
PHF	.000	.000	.000	.000	.250	.000	.000	.250	.000	.250	.000	.250	.250



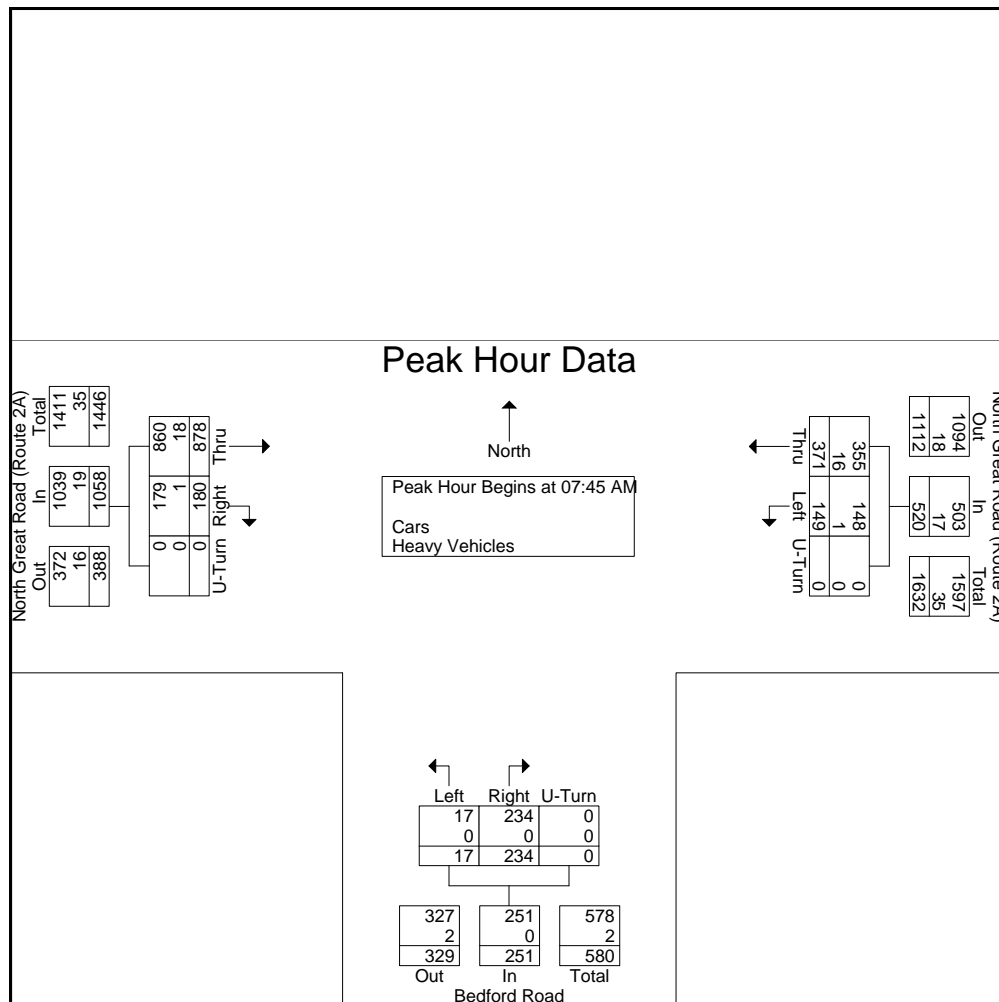
PRECISION
D A T A
INDUSTRIES, LLC

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S: Bedford Road
E/W: North Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 G
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

	North Great Road (Route 2A) From East				Bedford Road From South				North Great Road (Route 2A) From West				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:45 AM													
07:45 AM	113	49	0	162	59	5	0	64	51	197	0	248	474
08:00 AM	84	42	0	126	50	6	0	56	43	225	0	268	450
08:15 AM	86	30	0	116	61	2	0	63	46	221	0	267	446
08:30 AM	88	28	0	116	64	4	0	68	40	235	0	275	459
Total Volume	371	149	0	520	234	17	0	251	180	878	0	1058	1829
% App. Total	71.3	28.7	0		93.2	6.8	0		17	83	0		
PHF	.821	.760	.000	.802	.914	.708	.000	.923	.882	.934	.000	.962	.965
Cars	355	148	0	503	234	17	0	251	179	860	0	1039	1793
% Cars	95.7	99.3	0	96.7	100	100	0	100	99.4	97.9	0	98.2	98.0
Heavy Vehicles	16	1	0	17	0	0	0	0	1	18	0	19	36
% Heavy Vehicles	4.3	0.7	0	3.3	0	0	0	0	0.6	2.1	0	1.8	2.0





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N/S: Lexington Road (Rt 2A)/ Brooks Road
E/W: N.Great Rd (Rt 2A)/ Bypass Road
City, State: Lincoln, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 H
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Lexington Road (Route 2A) From North				North Great Road (Route 2A) From East				Brooks Road From South				Bypass Road From West				
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Int. Total
06:00 AM	1	0	17	0	4	26	0	0	0	0	0	0	0	68	1	0	117
06:15 AM	1	0	29	0	3	39	0	0	1	0	0	0	0	55	0	0	128
06:30 AM	2	0	71	0	10	36	0	0	0	0	0	0	0	89	6	0	214
06:45 AM	3	0	108	0	14	58	0	0	1	0	0	0	0	78	0	0	262
Total	7	0	225	0	31	159	0	0	2	0	0	0	0	290	7	0	721
07:00 AM	5	0	124	0	20	64	1	0	1	0	1	0	0	98	0	0	314
07:15 AM	0	0	137	0	15	70	0	0	2	0	0	0	1	113	0	0	338
07:30 AM	5	1	148	0	34	61	1	0	5	2	1	0	0	113	0	0	371
07:45 AM	9	0	135	0	43	74	0	0	1	0	0	0	0	107	1	0	370
Total	19	1	544	0	112	269	2	0	9	2	2	0	1	431	1	0	1393
08:00 AM	4	0	143	0	31	71	1	0	7	0	0	0	0	123	0	0	380
08:15 AM	4	0	143	0	27	57	1	0	3	4	0	0	0	121	1	0	361
08:30 AM	7	0	126	0	27	61	0	0	2	0	2	0	1	141	2	0	369
08:45 AM	4	2	111	0	22	70	1	0	4	0	0	0	1	102	1	0	318
Total	19	2	523	0	107	259	3	0	16	4	2	0	2	487	4	0	1428
Grand Total	45	3	1292	0	250	687	5	0	27	6	4	0	3	1208	12	0	3542
Apprch %	3.4	0.2	96.4	0	26.5	72.9	0.5	0	73	16.2	10.8	0	0.2	98.8	1	0	
Total %	1.3	0.1	36.5	0	7.1	19.4	0.1	0	0.8	0.2	0.1	0	0.1	34.1	0.3	0	
Cars	44	3	1284	0	242	658	5	0	26	6	4	0	2	1175	10	0	3459
% Cars	97.8	100	99.4	0	96.8	95.8	100	0	96.3	100	100	0	66.7	97.3	83.3	0	97.7
Heavy Vehicles	1	0	8	0	8	29	0	0	1	0	0	0	1	33	2	0	83
% Heavy Vehicles	2.2	0	0.6	0	3.2	4.2	0	0	3.7	0	0	0	33.3	2.7	16.7	0	2.3

	Lexington Road (Route 2A) From North					North Great Road (Route 2A) From East					Brooks Road From South					Bypass Road From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	5	1	148	0	154	34	61	1	0	96	5	2	1	0	8	0	113	0	0	113	371
07:45 AM	9	0	135	0	144	43	74	0	0	117	1	0	0	0	1	0	107	1	0	108	370
08:00 AM	4	0	143	0	147	31	71	1	0	103	7	0	0	0	7	0	123	0	0	123	380
08:15 AM	4	0	143	0	147	27	57	1	0	85	3	4	0	0	7	0	121	1	0	122	361
Total Volume	22	1	569	0	592	135	263	3	0	401	16	6	1	0	23	0	464	2	0	466	1482
% App. Total	3.7	0.2	96.1	0		33.7	65.6	0.7	0		69.6	26.1	4.3	0		0	99.6	0.4	0		
PHF	.611	.250	.961	.000	.961	.785	.889	.750	.000	.857	.571	.375	.250	.000	.719	.000	.943	.500	.000	.947	.975
Cars	22	1	565	0	588	133	248	3	0	384	15	6	1	0	22	0	451	2	0	453	1447
% Cars	100	100	99.3	0	99.3	98.5	94.3	100	0	95.8	93.8	100	100	0	95.7	0	97.2	100	0	97.2	97.6
Heavy Vehicles	0	0	4	0	4	2	15	0	0	17	1	0	0	0	1	0	13	0	0	13	35
% Heavy Vehicles	0	0	0.7	0	0.7	1.5	5.7	0	0	4.2	6.3	0	0	0	4.3	0	2.8	0	0	2.8	2.4



PRECISION
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N/S: Lexington Road (Rt 2A)/ Brooks Road
E/W: N.Great Rd (Rt 2A)/ Bypass Road
City, State: Lincoln, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 H
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars

	Lexington Road (Route 2A) From North				North Great Road (Route 2A) From East				Brooks Road From South				Bypass Road From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
06:00 AM	1	0	17	0	3	25	0	0	0	0	0	0	0	68	1	0	115
06:15 AM	0	0	29	0	2	38	0	0	1	0	0	0	0	54	0	0	124
06:30 AM	2	0	70	0	10	36	0	0	0	0	0	0	0	88	5	0	211
06:45 AM	3	0	107	0	14	56	0	0	1	0	0	0	0	74	0	0	255
Total	6	0	223	0	29	155	0	0	2	0	0	0	0	284	6	0	705
07:00 AM	5	0	123	0	19	62	1	0	1	0	1	0	0	96	0	0	308
07:15 AM	0	0	136	0	14	67	0	0	2	0	0	0	0	109	0	0	328
07:30 AM	5	1	147	0	33	59	1	0	4	2	1	0	0	110	0	0	363
07:45 AM	9	0	134	0	42	69	0	0	1	0	0	0	0	105	1	0	361
Total	19	1	540	0	108	257	2	0	8	2	2	0	0	420	1	0	1360
08:00 AM	4	0	143	0	31	70	1	0	7	0	0	0	0	119	0	0	375
08:15 AM	4	0	141	0	27	50	1	0	3	4	0	0	0	117	1	0	348
08:30 AM	7	0	126	0	26	61	0	0	2	0	2	0	1	135	2	0	362
08:45 AM	4	2	111	0	21	65	1	0	4	0	0	0	1	100	0	0	309
Total	19	2	521	0	105	246	3	0	16	4	2	0	2	471	3	0	1394
Grand Total	44	3	1284	0	242	658	5	0	26	6	4	0	2	1175	10	0	3459
Apprch %	3.3	0.2	96.5	0	26.7	72.7	0.6	0	72.2	16.7	11.1	0	0.2	99	0.8	0	
Total %	1.3	0.1	37.1	0	7	19	0.1	0	0.8	0.2	0.1	0	0.1	34	0.3	0	

	Lexington Road (Route 2A) From North					North Great Road (Route 2A) From East					Brooks Road From South					Bypass Road From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	5	1	147	0	153	33	59	1	0	93	4	2	1	0	7	0	110	0	0	110	363
07:45 AM	9	0	134	0	143	42	69	0	0	111	1	0	0	0	1	0	105	1	0	106	361
08:00 AM	4	0	143	0	147	31	70	1	0	102	7	0	0	0	7	0	119	0	0	119	375
08:15 AM	4	0	141	0	145	27	50	1	0	78	3	4	0	0	7	0	117	1	0	118	348
Total Volume	22	1	565	0	588	133	248	3	0	384	15	6	1	0	22	0	451	2	0	453	1447
% App. Total	3.7	0.2	96.1	0		34.6	64.6	0.8	0		68.2	27.3	4.5	0		0	99.6	0.4	0		
PHF	.611	.250	.961	.000	.961	.792	.886	.750	.000	.865	.536	.375	.250	.000	.786	.000	.947	.500	.000	.952	.965

N/S: Lexington Road (Rt 2A)/ Brooks Road
 E/W: N.Great Rd (Rt 2A)/ Bypass Road
 City, State: Lincoln, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 H
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

Groups Printed- Heavy Vehicles

	Lexington Road (Route 2A) From North				North Great Road (Route 2A) From East				Brooks Road From South				Bypass Road From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
06:00 AM	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	2
06:15 AM	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	4
06:30 AM	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	3
06:45 AM	0	0	1	0	0	2	0	0	0	0	0	0	0	4	0	0	7
Total	1	0	2	0	2	4	0	0	0	0	0	0	0	6	1	0	16
07:00 AM	0	0	1	0	1	2	0	0	0	0	0	0	0	2	0	0	6
07:15 AM	0	0	1	0	1	3	0	0	0	0	0	0	1	4	0	0	10
07:30 AM	0	0	1	0	1	2	0	0	1	0	0	0	0	3	0	0	8
07:45 AM	0	0	1	0	1	5	0	0	0	0	0	0	0	2	0	0	9
Total	0	0	4	0	4	12	0	0	1	0	0	0	1	11	0	0	33
08:00 AM	0	0	0	0	0	1	0	0	0	0	0	0	0	4	0	0	5
08:15 AM	0	0	2	0	0	7	0	0	0	0	0	0	0	4	0	0	13
08:30 AM	0	0	0	0	1	0	0	0	0	0	0	0	0	6	0	0	7
08:45 AM	0	0	0	0	1	5	0	0	0	0	0	0	0	2	1	0	9
Total	0	0	2	0	2	13	0	0	0	0	0	0	0	16	1	0	34
Grand Total	1	0	8	0	8	29	0	0	1	0	0	0	1	33	2	0	83
Apprch %	11.1	0	88.9	0	21.6	78.4	0	0	100	0	0	0	2.8	91.7	5.6	0	
Total %	1.2	0	9.6	0	9.6	34.9	0	0	1.2	0	0	0	1.2	39.8	2.4	0	

	Lexington Road (Route 2A) From North					North Great Road (Route 2A) From East					Brooks Road From South					Bypass Road From West					Int. Total
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	0	0	1	0	1	1	2	0	0	3	1	0	0	0	1	0	3	0	0	3	8
07:45 AM	0	0	1	0	1	1	5	0	0	6	0	0	0	0	0	0	2	0	0	2	9
08:00 AM	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	4	0	0	4	5
08:15 AM	0	0	2	0	2	0	7	0	0	7	0	0	0	0	0	0	4	0	0	4	13
Total Volume	0	0	4	0	4	2	15	0	0	17	1	0	0	0	1	0	13	0	0	13	35
% App. Total	0	0	100	0		11.8	88.2	0	0		100	0	0	0		0	100	0	0		
PHF	.000	.000	.500	.000	.500	.500	.536	.000	.000	.607	.250	.000	.000	.000	.250	.000	.813	.000	.000	.813	.673



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File Name : 123082 H
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Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

	Lexington Road (Route 2A) From North				North Great Road (Route 2A) From East				Brooks Road From South				Bypass Road From West				Int. Total
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	
06:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
06:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
08:30 AM	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	2
Grand Total	0	0	0	0	1	0	0	0	0	0	0	0	0	3	0	0	4
Apprch %	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	
Total %	0	0	0	0	25	0	0	0	0	0	0	0	0	75	0	0	

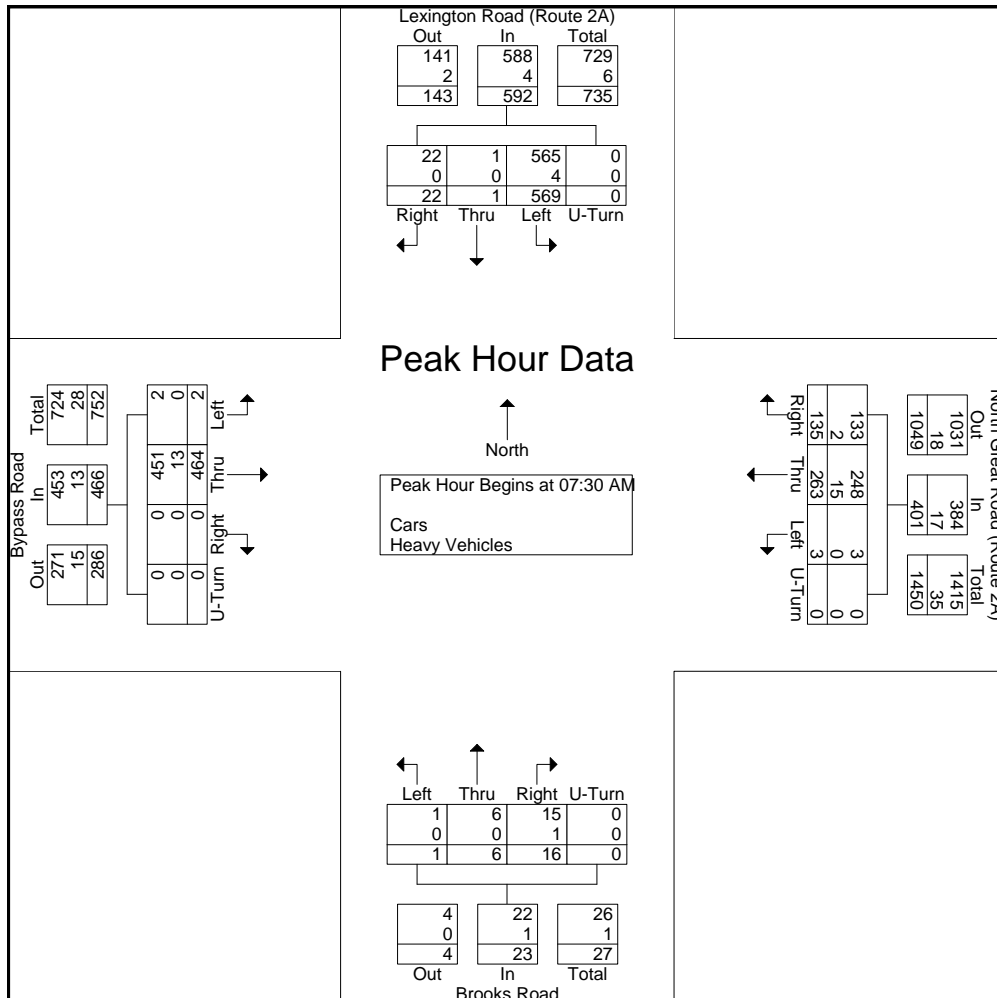
	Lexington Road (Route 2A) From North					North Great Road (Route 2A) From East					Brooks Road From South					Bypass Road From West					Int. Total
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:45 AM																					
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
08:30 AM	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Total Volume	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	1	2
% App. Total	0	0	0	0		100	0	0	0		0	0	0	0		0	100	0	0		
PHF	.000	.000	.000	.000	.000	.250	.000	.000	.000	.250	.000	.000	.000	.000	.000	.000	.250	.000	.000	.250	.500

N/S: Lexington Road (Rt 2A)/ Brooks Road
 E/W: N.Great Rd (Rt 2A)/ Bypass Road
 City, State: Lincoln, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 H
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

	Lexington Road (Route 2A) From North					North Great Road (Route 2A) From East					Brooks Road From South					Bypass Road From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	5	1	148	0	154	34	61	1	0	96	5	2	1	0	8	0	113	0	0	113	371
07:45 AM	9	0	135	0	144	43	74	0	0	117	1	0	0	0	1	0	107	1	0	108	370
08:00 AM	4	0	143	0	147	31	71	1	0	103	7	0	0	0	7	0	123	0	0	123	380
08:15 AM	4	0	143	0	147	27	57	1	0	85	3	4	0	0	7	0	121	1	0	122	361
Total Volume	22	1	569	0	592	135	263	3	0	401	16	6	1	0	23	0	464	2	0	466	1482
% App. Total	3.7	0.2	96.1	0		33.7	65.6	0.7	0		69.6	26.1	4.3	0		0	99.6	0.4	0		
PHF	.611	.250	.961	.000	.961	.785	.889	.750	.000	.857	.571	.375	.250	.000	.719	.000	.943	.500	.000	.947	.975
Cars	22	1	565	0	588	133	248	3	0	384	15	6	1	0	22	0	451	2	0	453	1447
% Cars	100	100	99.3	0	99.3	98.5	94.3	100	0	95.8	93.8	100	100	0	95.7	0	97.2	100	0	97.2	97.6
Heavy Vehicles	0	0	4	0	4	2	15	0	0	17	1	0	0	0	1	0	13	0	0	13	35
% Heavy Vehicles	0	0	0.7	0	0.7	1.5	5.7	0	0	4.2	6.3	0	0	0	4.3	0	2.8	0	0	2.8	2.4





PRECISION
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INDUSTRIES, LLC

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N: Old Bedford Road
E/W: Lexington Road
City, State: Concord, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 I
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Old Bedford Road From North			Lexington Road From East			Lexington Road From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
06:00 AM	5	4	0	0	3	0	14	15	0	41
06:15 AM	5	8	0	0	4	0	27	24	0	68
06:30 AM	9	20	0	6	6	0	47	35	0	123
06:45 AM	16	26	0	3	12	0	79	53	0	189
Total	35	58	0	9	25	0	167	127	0	421
07:00 AM	23	36	0	4	18	0	104	54	0	239
07:15 AM	27	32	0	4	13	0	110	99	0	285
07:30 AM	24	40	0	8	30	0	106	105	0	313
07:45 AM	28	43	0	13	34	0	110	109	0	337
Total	102	151	0	29	95	0	430	367	0	1174
08:00 AM	29	31	0	13	30	0	116	105	1	325
08:15 AM	33	18	0	16	19	0	97	108	0	291
08:30 AM	30	28	0	12	17	0	100	99	0	286
08:45 AM	32	26	0	15	18	0	84	105	0	280
Total	124	103	0	56	84	0	397	417	1	1182
Grand Total	261	312	0	94	204	0	994	911	1	2777
Apprch %	45.5	54.5	0	31.5	68.5	0	52.2	47.8	0.1	
Total %	9.4	11.2	0	3.4	7.3	0	35.8	32.8	0	
Cars	245	309	0	88	196	0	985	900	1	2724
% Cars	93.9	99	0	93.6	96.1	0	99.1	98.8	100	98.1
Heavy Vehicles	16	3	0	6	8	0	9	11	0	53
% Heavy Vehicles	6.1	1	0	6.4	3.9	0	0.9	1.2	0	1.9

	Old Bedford Road From North				Lexington Road From East				Lexington Road From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:30 AM													
07:30 AM	24	40	0	64	8	30	0	38	106	105	0	211	313
07:45 AM	28	43	0	71	13	34	0	47	110	109	0	219	337
08:00 AM	29	31	0	60	13	30	0	43	116	105	1	222	325
08:15 AM	33	18	0	51	16	19	0	35	97	108	0	205	291
Total Volume	114	132	0	246	50	113	0	163	429	427	1	857	1266
% App. Total	46.3	53.7	0		30.7	69.3	0		50.1	49.8	0.1		
PHF	.864	.767	.000	.866	.781	.831	.000	.867	.925	.979	.250	.965	.939
Cars	108	131	0	239	49	110	0	159	426	424	1	851	1249
% Cars	94.7	99.2	0	97.2	98.0	97.3	0	97.5	99.3	99.3	100	99.3	98.7
Heavy Vehicles	6	1	0	7	1	3	0	4	3	3	0	6	17
% Heavy Vehicles	5.3	0.8	0	2.8	2.0	2.7	0	2.5	0.7	0.7	0	0.7	1.3



PRECISION
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N: Old Bedford Road
E/W: Lexington Road
City, State: Concord, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 I
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars

	Old Bedford Road From North			Lexington Road From East			Lexington Road From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
06:00 AM	5	4	0	0	2	0	14	15	0	40
06:15 AM	5	7	0	0	3	0	27	24	0	66
06:30 AM	9	20	0	6	6	0	45	34	0	120
06:45 AM	13	26	0	2	12	0	78	53	0	184
Total	32	57	0	8	23	0	164	126	0	410
07:00 AM	21	36	0	3	17	0	103	53	0	233
07:15 AM	27	31	0	3	13	0	108	96	0	278
07:30 AM	19	40	0	7	28	0	105	104	0	303
07:45 AM	28	43	0	13	33	0	110	109	0	336
Total	95	150	0	26	91	0	426	362	0	1150
08:00 AM	29	30	0	13	30	0	116	105	1	324
08:15 AM	32	18	0	16	19	0	95	106	0	286
08:30 AM	28	28	0	11	16	0	100	97	0	280
08:45 AM	29	26	0	14	17	0	84	104	0	274
Total	118	102	0	54	82	0	395	412	1	1164
Grand Total	245	309	0	88	196	0	985	900	1	2724
Apprch %	44.2	55.8	0	31	69	0	52.2	47.7	0.1	
Total %	9	11.3	0	3.2	7.2	0	36.2	33	0	

	Old Bedford Road From North				Lexington Road From East				Lexington Road From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:30 AM													
07:30 AM	19	40	0	59	7	28	0	35	105	104	0	209	303
07:45 AM	28	43	0	71	13	33	0	46	110	109	0	219	336
08:00 AM	29	30	0	59	13	30	0	43	116	105	1	222	324
08:15 AM	32	18	0	50	16	19	0	35	95	106	0	201	286
Total Volume	108	131	0	239	49	110	0	159	426	424	1	851	1249
% App. Total	45.2	54.8	0		30.8	69.2	0		50.1	49.8	0.1		
PHF	.844	.762	.000	.842	.766	.833	.000	.864	.918	.972	.250	.958	.929



PRECISION
D A T A
INDUSTRIES, LLC

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N: Old Bedford Road
E/W: Lexington Road
City, State: Concord, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 I
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

	Old Bedford Road From North			Lexington Road From East			Lexington Road From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
06:00 AM	0	0	0	0	1	0	0	0	0	1
06:15 AM	0	1	0	0	1	0	0	0	0	2
06:30 AM	0	0	0	0	0	0	2	1	0	3
06:45 AM	3	0	0	1	0	0	1	0	0	5
Total	3	1	0	1	2	0	3	1	0	11
07:00 AM	2	0	0	1	1	0	1	1	0	6
07:15 AM	0	1	0	1	0	0	2	3	0	7
07:30 AM	5	0	0	1	2	0	1	1	0	10
07:45 AM	0	0	0	0	1	0	0	0	0	1
Total	7	1	0	3	4	0	4	5	0	24
08:00 AM	0	1	0	0	0	0	0	0	0	1
08:15 AM	1	0	0	0	0	0	2	2	0	5
08:30 AM	2	0	0	1	1	0	0	2	0	6
08:45 AM	3	0	0	1	1	0	0	1	0	6
Total	6	1	0	2	2	0	2	5	0	18
Grand Total	16	3	0	6	8	0	9	11	0	53
Apprch %	84.2	15.8	0	42.9	57.1	0	45	55	0	
Total %	30.2	5.7	0	11.3	15.1	0	17	20.8	0	

	Old Bedford Road From North				Lexington Road From East				Lexington Road From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 06:45 AM													
06:45 AM	3	0	0	3	1	0	0	1	1	0	0	1	5
07:00 AM	2	0	0	2	1	1	0	2	1	1	0	2	6
07:15 AM	0	1	0	1	1	0	0	1	2	3	0	5	7
07:30 AM	5	0	0	5	1	2	0	3	1	1	0	2	10
Total Volume	10	1	0	11	4	3	0	7	5	5	0	10	28
% App. Total	90.9	9.1	0		57.1	42.9	0		50	50	0		
PHF	.500	.250	.000	.550	1.00	.375	.000	.583	.625	.417	.000	.500	.700



PRECISION
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E/W: Lexington Road
City, State: Concord, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 I
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

	Old Bedford Road From North			Lexington Road From East			Lexington Road From West			
Start Time	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	Int. Total
06:00 AM	0	0	0	0	0	0	0	0	0	0
06:15 AM	0	0	0	0	0	0	0	0	0	0
06:30 AM	0	0	0	0	0	0	0	0	0	0
06:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0
07:00 AM	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	1	0	0	0	0	1
08:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	1	0	0	0	0	1
Grand Total	0	0	0	0	1	0	0	0	0	1
Apprch %	0	0	0	0	100	0	0	0	0	
Total %	0	0	0	0	100	0	0	0	0	

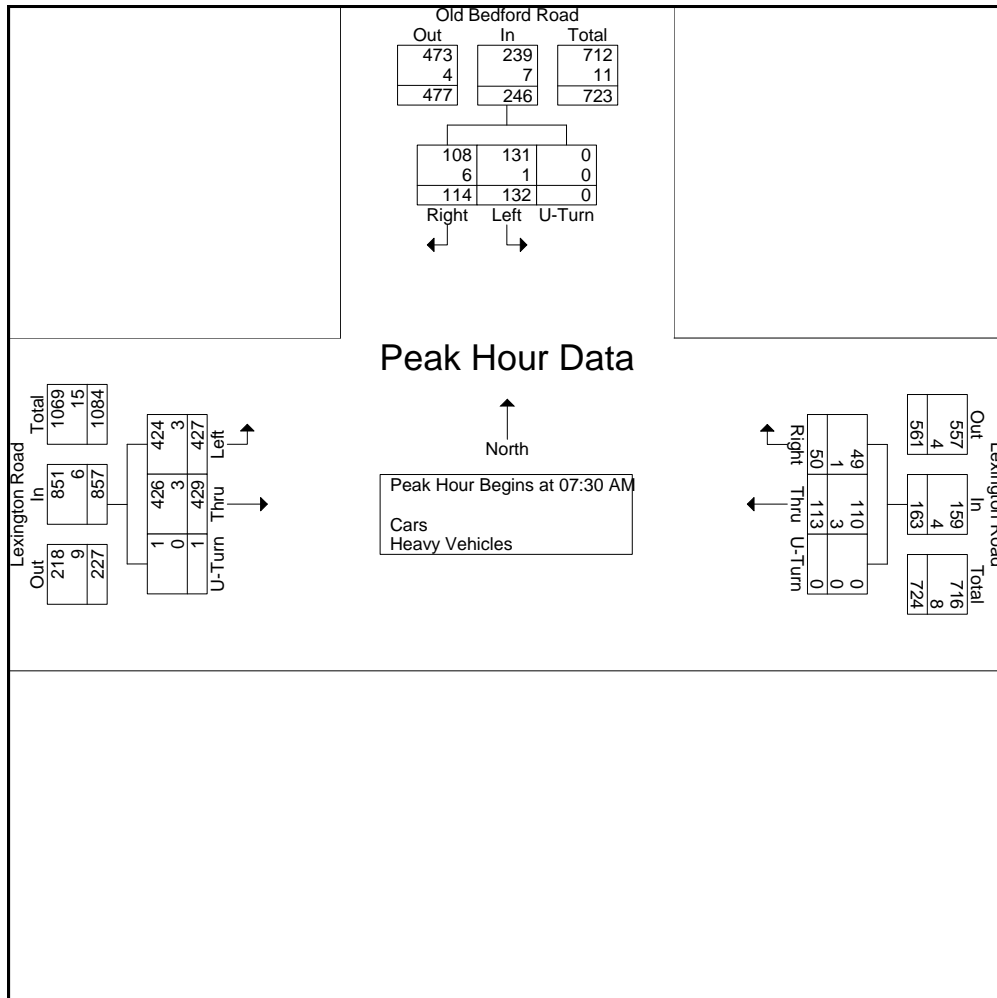
	Old Bedford Road From North				Lexington Road From East				Lexington Road From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:45 AM													
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	1	0	1	0	0	0	0	1
Total Volume	0	0	0	0	0	1	0	1	0	0	0	0	1
% App. Total	0	0	0		0	100	0		0	0	0		
PHF	.000	.000	.000	.000	.000	.250	.000	.250	.000	.000	.000	.000	.250

N: Old Bedford Road
 E/W: Lexington Road
 City, State: Concord, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 I
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

	Old Bedford Road From North				Lexington Road From East				Lexington Road From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:30 AM													
07:30 AM	24	40	0	64	8	30	0	38	106	105	0	211	313
07:45 AM	28	43	0	71	13	34	0	47	110	109	0	219	337
08:00 AM	29	31	0	60	13	30	0	43	116	105	1	222	325
08:15 AM	33	18	0	51	16	19	0	35	97	108	0	205	291
Total Volume	114	132	0	246	50	113	0	163	429	427	1	857	1266
% App. Total	46.3	53.7	0		30.7	69.3	0		50.1	49.8	0.1		
PHF	.864	.767	.000	.866	.781	.831	.000	.867	.925	.979	.250	.965	.939
Cars	108	131	0	239	49	110	0	159	426	424	1	851	1249
% Cars	94.7	99.2	0	97.2	98.0	97.3	0	97.5	99.3	99.3	100	99.3	98.7
Heavy Vehicles	6	1	0	7	1	3	0	4	3	3	0	6	17
% Heavy Vehicles	5.3	0.8	0	2.8	2.0	2.7	0	2.5	0.7	0.7	0	0.7	1.3





PRECISION
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N/S: Old Bedford Road
E/W: Virginia Road
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 J
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

Start Time	Old Bedford Road From North			Virginia Road From East			Old Bedford Road From South			Int. Total
	Thru	Left	U-Turn	Right	Left	U-Turn	Right	Thru	U-Turn	
06:00 AM	11	11	0	1	4	0	17	3	0	47
06:15 AM	14	11	0	0	0	0	18	3	0	46
06:30 AM	29	15	0	2	3	0	31	7	1	88
06:45 AM	34	27	0	4	4	0	43	12	0	124
Total	88	64	0	7	11	0	109	25	1	305
07:00 AM	56	33	0	2	6	0	39	17	0	153
07:15 AM	43	40	0	5	13	0	73	22	0	196
07:30 AM	56	38	0	5	8	0	68	35	0	210
07:45 AM	47	45	0	2	3	0	64	35	0	196
Total	202	156	0	14	30	0	244	109	0	755
08:00 AM	37	25	0	6	10	0	74	30	0	182
08:15 AM	46	32	0	2	4	0	71	40	0	195
08:30 AM	43	33	0	5	5	0	69	37	0	192
08:45 AM	46	33	0	2	5	0	54	51	0	191
Total	172	123	0	15	24	0	268	158	0	760
Grand Total	462	343	0	36	65	0	621	292	1	1820
Apprch %	57.4	42.6	0	35.6	64.4	0	67.9	31.9	0.1	
Total %	25.4	18.8	0	2	3.6	0	34.1	16	0.1	
Cars	449	342	0	35	61	0	616	287	1	1791
% Cars	97.2	99.7	0	97.2	93.8	0	99.2	98.3	100	98.4
Heavy Vehicles	13	1	0	1	4	0	5	5	0	29
% Heavy Vehicles	2.8	0.3	0	2.8	6.2	0	0.8	1.7	0	1.6

	Old Bedford Road From North				Virginia Road From East				Old Bedford Road From South				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:15 AM													
07:15 AM	43	40	0	83	5	13	0	18	73	22	0	95	196
07:30 AM	56	38	0	94	5	8	0	13	68	35	0	103	210
07:45 AM	47	45	0	92	2	3	0	5	64	35	0	99	196
08:00 AM	37	25	0	62	6	10	0	16	74	30	0	104	182
Total Volume	183	148	0	331	18	34	0	52	279	122	0	401	784
% App. Total	55.3	44.7	0		34.6	65.4	0		69.6	30.4	0		
PHF	.817	.822	.000	.880	.750	.654	.000	.722	.943	.871	.000	.964	.933
Cars	180	148	0	328	18	33	0	51	278	119	0	397	776
% Cars	98.4	100	0	99.1	100	97.1	0	98.1	99.6	97.5	0	99.0	99.0
Heavy Vehicles	3	0	0	3	0	1	0	1	1	3	0	4	8
% Heavy Vehicles	1.6	0	0	0.9	0	2.9	0	1.9	0.4	2.5	0	1.0	1.0



PRECISION
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N/S: Old Bedford Road
E/W: Virginia Road
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 J
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars

Start Time	Old Bedford Road From North			Virginia Road From East			Old Bedford Road From South			Int. Total
	Thru	Left	U-Turn	Right	Left	U-Turn	Right	Thru	U-Turn	
06:00 AM	10	11	0	1	4	0	17	3	0	46
06:15 AM	13	11	0	0	0	0	18	3	0	45
06:30 AM	29	15	0	2	3	0	30	7	1	87
06:45 AM	32	27	0	3	3	0	42	12	0	119
Total	84	64	0	6	10	0	107	25	1	297
07:00 AM	54	32	0	2	6	0	38	17	0	149
07:15 AM	42	40	0	5	13	0	73	20	0	193
07:30 AM	54	38	0	5	7	0	67	34	0	205
07:45 AM	47	45	0	2	3	0	64	35	0	196
Total	197	155	0	14	29	0	242	106	0	743
08:00 AM	37	25	0	6	10	0	74	30	0	182
08:15 AM	44	32	0	2	3	0	71	40	0	192
08:30 AM	42	33	0	5	5	0	68	36	0	189
08:45 AM	45	33	0	2	4	0	54	50	0	188
Total	168	123	0	15	22	0	267	156	0	751
Grand Total	449	342	0	35	61	0	616	287	1	1791
Apprch %	56.8	43.2	0	36.5	63.5	0	68.1	31.7	0.1	
Total %	25.1	19.1	0	2	3.4	0	34.4	16	0.1	

	Old Bedford Road From North				Virginia Road From East				Old Bedford Road From South				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:15 AM													
07:15 AM	42	40	0	82	5	13	0	18	73	20	0	93	193
07:30 AM	54	38	0	92	5	7	0	12	67	34	0	101	205
07:45 AM	47	45	0	92	2	3	0	5	64	35	0	99	196
08:00 AM	37	25	0	62	6	10	0	16	74	30	0	104	182
Total Volume	180	148	0	328	18	33	0	51	278	119	0	397	776
% App. Total	54.9	45.1	0		35.3	64.7	0		70	30	0		
PHF	.833	.822	.000	.891	.750	.635	.000	.708	.939	.850	.000	.954	.946



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
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Email: datarequests@pdillc.com

N/S: Old Bedford Road
E/W: Virginia Road
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 J
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

Start Time	Old Bedford Road From North			Virginia Road From East			Old Bedford Road From South			Int. Total
	Thru	Left	U-Turn	Right	Left	U-Turn	Right	Thru	U-Turn	
06:00 AM	1	0	0	0	0	0	0	0	0	1
06:15 AM	1	0	0	0	0	0	0	0	0	1
06:30 AM	0	0	0	0	0	0	1	0	0	1
06:45 AM	2	0	0	1	1	0	1	0	0	5
Total	4	0	0	1	1	0	2	0	0	8
07:00 AM	2	1	0	0	0	0	1	0	0	4
07:15 AM	1	0	0	0	0	0	0	2	0	3
07:30 AM	2	0	0	0	1	0	1	1	0	5
07:45 AM	0	0	0	0	0	0	0	0	0	0
Total	5	1	0	0	1	0	2	3	0	12
08:00 AM	0	0	0	0	0	0	0	0	0	0
08:15 AM	2	0	0	0	1	0	0	0	0	3
08:30 AM	1	0	0	0	0	0	1	1	0	3
08:45 AM	1	0	0	0	1	0	0	1	0	3
Total	4	0	0	0	2	0	1	2	0	9
Grand Total	13	1	0	1	4	0	5	5	0	29
Apprch %	92.9	7.1	0	20	80	0	50	50	0	
Total %	44.8	3.4	0	3.4	13.8	0	17.2	17.2	0	

	Old Bedford Road From North				Virginia Road From East				Old Bedford Road From South				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 06:45 AM													
06:45 AM	2	0	0	2	1	1	0	2	1	0	0	1	5
07:00 AM	2	1	0	3	0	0	0	0	1	0	0	1	4
07:15 AM	1	0	0	1	0	0	0	0	0	2	0	2	3
07:30 AM	2	0	0	2	0	1	0	1	1	1	0	2	5
Total Volume	7	1	0	8	1	2	0	3	3	3	0	6	17
% App. Total	87.5	12.5	0		33.3	66.7	0		50	50	0		
PHF	.875	.250	.000	.667	.250	.500	.000	.375	.750	.375	.000	.750	.850



PRECISION
D A T A
INDUSTRIES, LLC

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N/S: Old Bedford Road
E/W: Virginia Road
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 J
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

Start Time	Old Bedford Road From North			Virginia Road From East			Old Bedford Road From South			Int. Total
	Thru	Left	Peds	Right	Left	Peds	Right	Thru	Peds	
06:00 AM	0	0	0	0	0	0	0	0	0	0
06:15 AM	0	0	0	0	0	1	0	0	0	1
06:30 AM	0	0	1	0	0	0	0	0	0	1
06:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	0	1	0	0	1	0	0	0	2
07:00 AM	0	0	0	0	0	0	0	0	0	0
07:15 AM	1	0	0	0	0	0	0	0	1	2
07:30 AM	0	0	0	0	0	1	0	0	0	1
07:45 AM	0	0	0	0	0	0	0	0	0	0
Total	1	0	0	0	0	1	0	0	1	3
08:00 AM	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0
Grand Total	1	0	1	0	0	2	0	0	1	5
Apprch %	50	0	50	0	0	100	0	0	100	
Total %	20	0	20	0	0	40	0	0	20	

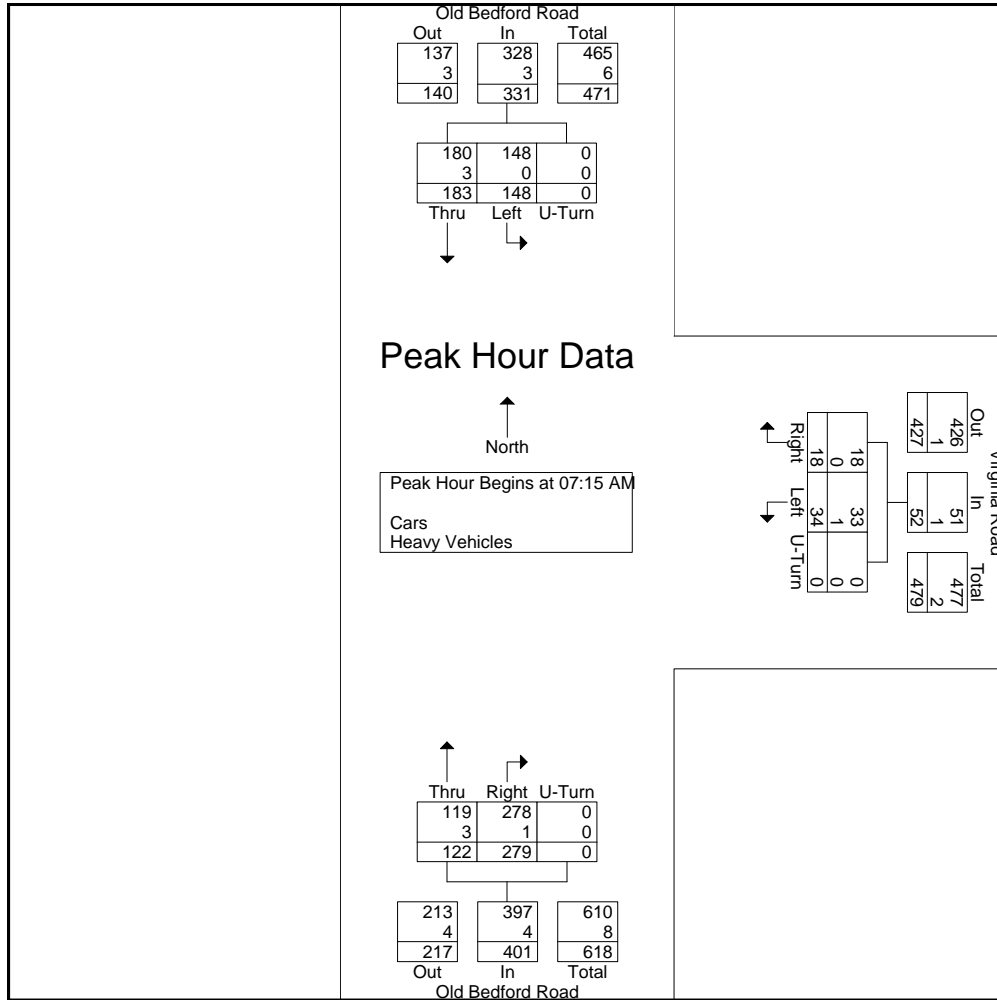
	Old Bedford Road From North				Virginia Road From East				Old Bedford Road From South				
Start Time	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 06:30 AM													
06:30 AM	0	0	1	1	0	0	0	0	0	0	0	0	1
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	1	0	0	1	0	0	0	0	0	0	1	1	2
Total Volume	1	0	1	2	0	0	0	0	0	0	1	1	3
% App. Total	50	0	50		0	0	0		0	0	100		
PHF	.250	.000	.250	.500	.000	.000	.000	.000	.000	.000	.250	.250	.375

N/S: Old Bedford Road
 E/W: Virginia Road
 City, State: Bedford, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 J
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

	Old Bedford Road From North				Virginia Road From East				Old Bedford Road From South				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:15 AM													
07:15 AM	43	40	0	83	5	13	0	18	73	22	0	95	196
07:30 AM	56	38	0	94	5	8	0	13	68	35	0	103	210
07:45 AM	47	45	0	92	2	3	0	5	64	35	0	99	196
08:00 AM	37	25	0	62	6	10	0	16	74	30	0	104	182
Total Volume	183	148	0	331	18	34	0	52	279	122	0	401	784
% App. Total	55.3	44.7	0		34.6	65.4	0		69.6	30.4	0		
PHF	.817	.822	.000	.880	.750	.654	.000	.722	.943	.871	.000	.964	.933
Cars	180	148	0	328	18	33	0	51	278	119	0	397	776
% Cars	98.4	100	0	99.1	100	97.1	0	98.1	99.6	97.5	0	99.0	99.0
Heavy Vehicles	3	0	0	3	0	1	0	1	1	3	0	4	8
% Heavy Vehicles	1.6	0	0	0.9	0	2.9	0	1.9	0.4	2.5	0	1.0	1.0





PRECISION
D A T A
INDUSTRIES, LLC

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Email: datarequests@pdillc.com

S: Old Bedford Road
E/W: Bedford Street (Route 62)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 K
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Bedford Street (Route 62) From East			Old Bedford Road From South			Bedford Street (Route 62) From West			
Start Time	Thru	Left	U-Turn	Right	Left	U-Turn	Right	Thru	U-Turn	Int. Total
06:00 AM	18	7	0	3	0	0	3	21	0	52
06:15 AM	27	22	0	4	0	0	2	25	0	80
06:30 AM	32	36	0	8	0	0	6	37	0	119
06:45 AM	41	49	0	16	1	0	10	56	0	173
Total	118	114	0	31	1	0	21	139	0	424
07:00 AM	54	75	0	15	3	0	13	73	0	233
07:15 AM	54	65	0	21	3	0	16	67	0	226
07:30 AM	57	88	0	32	5	0	10	86	0	278
07:45 AM	69	72	0	45	3	0	25	99	0	313
Total	234	300	0	113	14	0	64	325	0	1050
08:00 AM	59	62	0	32	4	0	13	114	0	284
08:15 AM	62	75	0	52	1	0	14	115	0	319
08:30 AM	71	63	0	41	3	0	14	91	0	283
08:45 AM	63	65	0	54	5	0	10	106	0	303
Total	255	265	0	179	13	0	51	426	0	1189
Grand Total	607	679	0	323	28	0	136	890	0	2663
Apprch %	47.2	52.8	0	92	8	0	13.3	86.7	0	
Total %	22.8	25.5	0	12.1	1.1	0	5.1	33.4	0	
Cars	589	670	0	318	27	0	133	871	0	2608
% Cars	97	98.7	0	98.5	96.4	0	97.8	97.9	0	97.9
Heavy Vehicles	18	9	0	5	1	0	3	19	0	55
% Heavy Vehicles	3	1.3	0	1.5	3.6	0	2.2	2.1	0	2.1

	Bedford Street (Route 62) From East				Old Bedford Road From South				Bedford Street (Route 62) From West				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:45 AM													
07:45 AM	69	72	0	141	45	3	0	48	25	99	0	124	313
08:00 AM	59	62	0	121	32	4	0	36	13	114	0	127	284
08:15 AM	62	75	0	137	52	1	0	53	14	115	0	129	319
08:30 AM	71	63	0	134	41	3	0	44	14	91	0	105	283
Total Volume	261	272	0	533	170	11	0	181	66	419	0	485	1199
% App. Total	49	51	0		93.9	6.1	0		13.6	86.4	0		
PHF	.919	.907	.000	.945	.817	.688	.000	.854	.660	.911	.000	.940	.940
Cars	251	267	0	518	169	11	0	180	66	412	0	478	1176
% Cars	96.2	98.2	0	97.2	99.4	100	0	99.4	100	98.3	0	98.6	98.1
Heavy Vehicles	10	5	0	15	1	0	0	1	0	7	0	7	23
% Heavy Vehicles	3.8	1.8	0	2.8	0.6	0	0	0.6	0	1.7	0	1.4	1.9



PRECISION
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INDUSTRIES, LLC

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S: Old Bedford Road
E/W: Bedford Street (Route 62)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 K
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars

	Bedford Street (Route 62) From East			Old Bedford Road From South			Bedford Street (Route 62) From West			
Start Time	Thru	Left	U-Turn	Right	Left	U-Turn	Right	Thru	U-Turn	Int. Total
06:00 AM	18	7	0	3	0	0	3	21	0	52
06:15 AM	27	22	0	4	0	0	2	23	0	78
06:30 AM	32	36	0	8	0	0	6	36	0	118
06:45 AM	39	48	0	15	1	0	10	54	0	167
Total	116	113	0	30	1	0	21	134	0	415
07:00 AM	53	74	0	15	3	0	11	69	0	225
07:15 AM	53	64	0	19	3	0	16	67	0	222
07:30 AM	53	87	0	32	4	0	9	83	0	268
07:45 AM	66	71	0	45	3	0	25	97	0	307
Total	225	296	0	111	13	0	61	316	0	1022
08:00 AM	56	62	0	32	4	0	13	114	0	281
08:15 AM	59	73	0	52	1	0	14	111	0	310
08:30 AM	70	61	0	40	3	0	14	90	0	278
08:45 AM	63	65	0	53	5	0	10	106	0	302
Total	248	261	0	177	13	0	51	421	0	1171
Grand Total	589	670	0	318	27	0	133	871	0	2608
Apprch %	46.8	53.2	0	92.2	7.8	0	13.2	86.8	0	
Total %	22.6	25.7	0	12.2	1	0	5.1	33.4	0	

	Bedford Street (Route 62) From East				Old Bedford Road From South				Bedford Street (Route 62) From West				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:45 AM													
07:45 AM	66	71	0	137	45	3	0	48	25	97	0	122	307
08:00 AM	56	62	0	118	32	4	0	36	13	114	0	127	281
08:15 AM	59	73	0	132	52	1	0	53	14	111	0	125	310
08:30 AM	70	61	0	131	40	3	0	43	14	90	0	104	278
Total Volume	251	267	0	518	169	11	0	180	66	412	0	478	1176
% App. Total	48.5	51.5	0		93.9	6.1	0		13.8	86.2	0		
PHF	.896	.914	.000	.945	.813	.688	.000	.849	.660	.904	.000	.941	.948



PRECISION
D A T A
INDUSTRIES, LLC

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S: Old Bedford Road
E/W: Bedford Street (Route 62)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 K
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

	Bedford Street (Route 62) From East			Old Bedford Road From South			Bedford Street (Route 62) From West			
Start Time	Thru	Left	U-Turn	Right	Left	U-Turn	Right	Thru	U-Turn	Int. Total
06:00 AM	0	0	0	0	0	0	0	0	0	0
06:15 AM	0	0	0	0	0	0	0	2	0	2
06:30 AM	0	0	0	0	0	0	0	1	0	1
06:45 AM	2	1	0	1	0	0	0	2	0	6
Total	2	1	0	1	0	0	0	5	0	9
07:00 AM	1	1	0	0	0	0	2	4	0	8
07:15 AM	1	1	0	2	0	0	0	0	0	4
07:30 AM	4	1	0	0	1	0	1	3	0	10
07:45 AM	3	1	0	0	0	0	0	2	0	6
Total	9	4	0	2	1	0	3	9	0	28
08:00 AM	3	0	0	0	0	0	0	0	0	3
08:15 AM	3	2	0	0	0	0	0	4	0	9
08:30 AM	1	2	0	1	0	0	0	1	0	5
08:45 AM	0	0	0	1	0	0	0	0	0	1
Total	7	4	0	2	0	0	0	5	0	18
Grand Total	18	9	0	5	1	0	3	19	0	55
Apprch %	66.7	33.3	0	83.3	16.7	0	13.6	86.4	0	
Total %	32.7	16.4	0	9.1	1.8	0	5.5	34.5	0	

	Bedford Street (Route 62) From East				Old Bedford Road From South				Bedford Street (Route 62) From West				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 06:45 AM													
06:45 AM	2	1	0	3	1	0	0	1	0	2	0	2	6
07:00 AM	1	1	0	2	0	0	0	0	2	4	0	6	8
07:15 AM	1	1	0	2	2	0	0	2	0	0	0	0	4
07:30 AM	4	1	0	5	0	1	0	1	1	3	0	4	10
Total Volume	8	4	0	12	3	1	0	4	3	9	0	12	28
% App. Total	66.7	33.3	0		75	25	0		25	75	0		
PHF	.500	1.00	.000	.600	.375	.250	.000	.500	.375	.563	.000	.500	.700



PRECISION
D A T A
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S: Old Bedford Road
E/W: Bedford Street (Route 62)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 K
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

Start Time	Bedford Street (Route 62) From East			Old Bedford Road From South			Bedford Street (Route 62) From West			Int. Total
	Thru	Left	Peds	Right	Left	Peds	Right	Thru	Peds	
06:00 AM	0	0	0	0	0	0	0	0	0	0
06:15 AM	0	0	2	0	0	0	0	0	0	2
06:30 AM	0	0	1	0	0	0	0	0	0	1
06:45 AM	0	0	0	0	0	0	0	1	0	1
Total	0	0	3	0	0	0	0	1	0	4
07:00 AM	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	1	0	0	0	0	0	0	0	1
07:30 AM	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	1	0	0	0	0	0	0	0	1
08:00 AM	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0
Grand Total	0	1	3	0	0	0	0	1	0	5
Apprch %	0	25	75	0	0	0	0	100	0	
Total %	0	20	60	0	0	0	0	20	0	

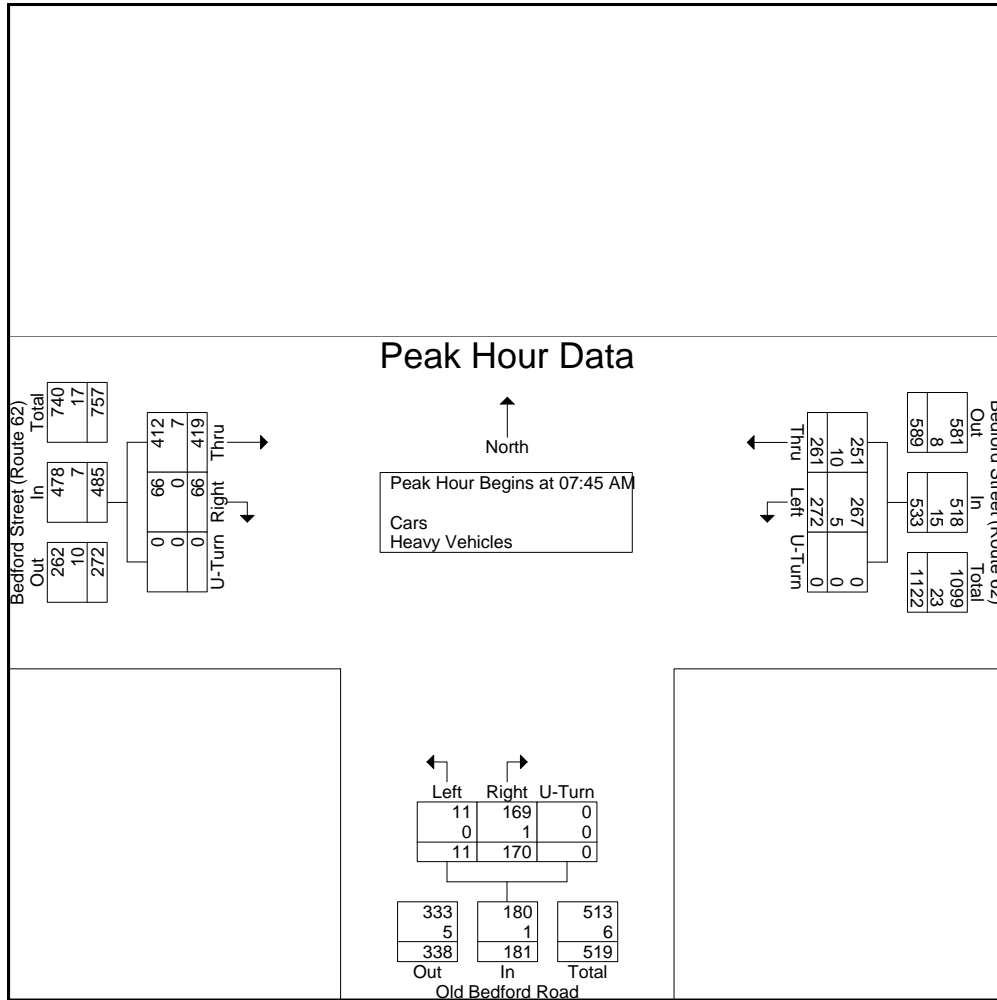
	Bedford Street (Route 62) From East				Old Bedford Road From South				Bedford Street (Route 62) From West				
Start Time	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 06:00 AM													
06:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
06:15 AM	0	0	2	2	0	0	0	0	0	0	0	0	2
06:30 AM	0	0	1	1	0	0	0	0	0	0	0	0	1
06:45 AM	0	0	0	0	0	0	0	0	0	1	0	1	1
Total Volume	0	0	3	3	0	0	0	0	0	1	0	1	4
% App. Total	0	0	100		0	0	0		0	100	0		
PHF	.000	.000	.375	.375	.000	.000	.000	.000	.000	.250	.000	.250	.500

S: Old Bedford Road
 E/W: Bedford Street (Route 62)
 City, State: Bedford, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 K
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

	Bedford Street (Route 62) From East				Old Bedford Road From South				Bedford Street (Route 62) From West				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:45 AM													
07:45 AM	69	72	0	141	45	3	0	48	25	99	0	124	313
08:00 AM	59	62	0	121	32	4	0	36	13	114	0	127	284
08:15 AM	62	75	0	137	52	1	0	53	14	115	0	129	319
08:30 AM	71	63	0	134	41	3	0	44	14	91	0	105	283
Total Volume	261	272	0	533	170	11	0	181	66	419	0	485	1199
% App. Total	49	51	0		93.9	6.1	0		13.6	86.4	0		
PHF	.919	.907	.000	.945	.817	.688	.000	.854	.660	.911	.000	.940	.940
Cars	251	267	0	518	169	11	0	180	66	412	0	478	1176
% Cars	96.2	98.2	0	97.2	99.4	100	0	99.4	100	98.3	0	98.6	98.1
Heavy Vehicles	10	5	0	15	1	0	0	1	0	7	0	7	23
% Heavy Vehicles	3.8	1.8	0	2.8	0.6	0	0	0.6	0	1.7	0	1.4	1.9





PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
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Email: datarequests@pdillc.com

S: Hartwell Road
E/W: Concord Road (Route 62)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 L
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Concord Road (Route 62) From East			Hartwell Road From South			Concord Road (Route 62) From West			
Start Time	Thru	Left	U-Turn	Right	Left	U-Turn	Right	Thru	U-Turn	Int. Total
06:00 AM	26	25	0	2	0	0	6	27	0	86
06:15 AM	39	14	0	3	2	0	6	31	0	95
06:30 AM	67	8	0	0	5	0	11	44	0	135
06:45 AM	90	26	1	0	5	0	11	55	0	188
Total	222	73	1	5	12	0	34	157	0	504
07:00 AM	91	25	0	1	10	0	18	86	0	231
07:15 AM	90	7	0	2	12	0	24	89	0	224
07:30 AM	133	20	0	6	9	0	34	121	0	323
07:45 AM	106	19	0	5	11	0	47	107	0	295
Total	420	71	0	14	42	0	123	403	0	1073
08:00 AM	120	30	0	2	11	0	43	124	0	330
08:15 AM	109	27	0	3	13	0	44	141	0	337
08:30 AM	131	12	0	9	9	0	28	124	0	313
08:45 AM	148	11	0	3	14	0	38	158	0	372
Total	508	80	0	17	47	0	153	547	0	1352
Grand Total	1150	224	1	36	101	0	310	1107	0	2929
Apprch %	83.6	16.3	0.1	26.3	73.7	0	21.9	78.1	0	
Total %	39.3	7.6	0	1.2	3.4	0	10.6	37.8	0	
Cars	1115	219	1	33	94	0	304	1082	0	2848
% Cars	97	97.8	100	91.7	93.1	0	98.1	97.7	0	97.2
Heavy Vehicles	35	5	0	3	7	0	6	25	0	81
% Heavy Vehicles	3	2.2	0	8.3	6.9	0	1.9	2.3	0	2.8

	Concord Road (Route 62) From East				Hartwell Road From South				Concord Road (Route 62) From West				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 08:00 AM													
08:00 AM	120	30	0	150	2	11	0	13	43	124	0	167	330
08:15 AM	109	27	0	136	3	13	0	16	44	141	0	185	337
08:30 AM	131	12	0	143	9	9	0	18	28	124	0	152	313
08:45 AM	148	11	0	159	3	14	0	17	38	158	0	196	372
Total Volume	508	80	0	588	17	47	0	64	153	547	0	700	1352
% App. Total	86.4	13.6	0		26.6	73.4	0		21.9	78.1	0		
PHF	.858	.667	.000	.925	.472	.839	.000	.889	.869	.866	.000	.893	.909
Cars	484	80	0	564	15	45	0	60	152	535	0	687	1311
% Cars	95.3	100	0	95.9	88.2	95.7	0	93.8	99.3	97.8	0	98.1	97.0
Heavy Vehicles	24	0	0	24	2	2	0	4	1	12	0	13	41
% Heavy Vehicles	4.7	0	0	4.1	11.8	4.3	0	6.3	0.7	2.2	0	1.9	3.0

S: Hartwell Road
 E/W: Concord Road (Route 62)
 City, State: Bedford, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 L
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

Groups Printed- Cars										
	Concord Road (Route 62) From East			Hartwell Road From South			Concord Road (Route 62) From West			
Start Time	Thru	Left	U-Turn	Right	Left	U-Turn	Right	Thru	U-Turn	Int. Total
06:00 AM	26	25	0	2	0	0	6	27	0	86
06:15 AM	39	14	0	3	2	0	6	29	0	93
06:30 AM	66	8	0	0	5	0	11	44	0	134
06:45 AM	89	25	1	0	4	0	11	54	0	184
Total	220	72	1	5	11	0	34	154	0	497
07:00 AM	89	21	0	1	10	0	16	83	0	220
07:15 AM	88	7	0	2	9	0	24	83	0	213
07:30 AM	131	20	0	5	9	0	34	121	0	320
07:45 AM	103	19	0	5	10	0	44	106	0	287
Total	411	67	0	13	38	0	118	393	0	1040
08:00 AM	115	30	0	2	9	0	43	123	0	322
08:15 AM	103	27	0	2	13	0	44	137	0	326
08:30 AM	126	12	0	8	9	0	28	121	0	304
08:45 AM	140	11	0	3	14	0	37	154	0	359
Total	484	80	0	15	45	0	152	535	0	1311
Grand Total	1115	219	1	33	94	0	304	1082	0	2848
Apprch %	83.5	16.4	0.1	26	74	0	21.9	78.1	0	
Total %	39.2	7.7	0	1.2	3.3	0	10.7	38	0	

	Concord Road (Route 62) From East				Hartwell Road From South				Concord Road (Route 62) From West				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 08:00 AM													
08:00 AM	115	30	0	145	2	9	0	11	43	123	0	166	322
08:15 AM	103	27	0	130	2	13	0	15	44	137	0	181	326
08:30 AM	126	12	0	138	8	9	0	17	28	121	0	149	304
08:45 AM	140	11	0	151	3	14	0	17	37	154	0	191	359
Total Volume	484	80	0	564	15	45	0	60	152	535	0	687	1311
% App. Total	85.8	14.2	0		25	75	0		22.1	77.9	0		
PHF	.864	.667	.000	.934	.469	.804	.000	.882	.864	.869	.000	.899	.913

S: Hartwell Road
 E/W: Concord Road (Route 62)
 City, State: Bedford, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 L
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

Groups Printed- Heavy Vehicles

Start Time	Concord Road (Route 62) From East			Hartwell Road From South			Concord Road (Route 62) From West			Int. Total
	Thru	Left	U-Turn	Right	Left	U-Turn	Right	Thru	U-Turn	
06:00 AM	0	0	0	0	0	0	0	0	0	0
06:15 AM	0	0	0	0	0	0	0	2	0	2
06:30 AM	1	0	0	0	0	0	0	0	0	1
06:45 AM	1	1	0	0	1	0	0	1	0	4
Total	2	1	0	0	1	0	0	3	0	7
07:00 AM	2	4	0	0	0	0	2	3	0	11
07:15 AM	2	0	0	0	3	0	0	6	0	11
07:30 AM	2	0	0	1	0	0	0	0	0	3
07:45 AM	3	0	0	0	1	0	3	1	0	8
Total	9	4	0	1	4	0	5	10	0	33
08:00 AM	5	0	0	0	2	0	0	1	0	8
08:15 AM	6	0	0	1	0	0	0	4	0	11
08:30 AM	5	0	0	1	0	0	0	3	0	9
08:45 AM	8	0	0	0	0	0	1	4	0	13
Total	24	0	0	2	2	0	1	12	0	41
Grand Total	35	5	0	3	7	0	6	25	0	81
Apprch %	87.5	12.5	0	30	70	0	19.4	80.6	0	
Total %	43.2	6.2	0	3.7	8.6	0	7.4	30.9	0	

	Concord Road (Route 62) From East				Hartwell Road From South				Concord Road (Route 62) From West				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 08:00 AM													
08:00 AM	5	0	0	5	0	2	0	2	0	1	0	1	8
08:15 AM	6	0	0	6	1	0	0	1	0	4	0	4	11
08:30 AM	5	0	0	5	1	0	0	1	0	3	0	3	9
08:45 AM	8	0	0	8	0	0	0	0	1	4	0	5	13
Total Volume	24	0	0	24	2	2	0	4	1	12	0	13	41
% App. Total	100	0	0		50	50	0		7.7	92.3	0		
PHF	.750	.000	.000	.750	.500	.250	.000	.500	.250	.750	.000	.650	.788



PRECISION
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S: Hartwell Road
E/W: Concord Road (Route 62)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 L
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

Start Time	Concord Road (Route 62) From East			Hartwell Road From South			Concord Road (Route 62) From West			Int. Total
	Thru	Left	Peds	Right	Left	Peds	Right	Thru	Peds	
06:00 AM	0	0	0	0	0	0	0	0	0	0
06:15 AM	0	0	0	0	0	0	0	0	0	0
06:30 AM	0	0	0	0	0	0	0	0	0	0
06:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0
07:00 AM	1	0	0	0	0	0	0	1	0	2
07:15 AM	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0
Total	1	0	0	0	0	0	0	1	0	2
08:00 AM	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0
Grand Total	1	0	0	0	0	0	0	1	0	2
Apprch %	100	0	0	0	0	0	0	100	0	
Total %	50	0	0	0	0	0	0	50	0	

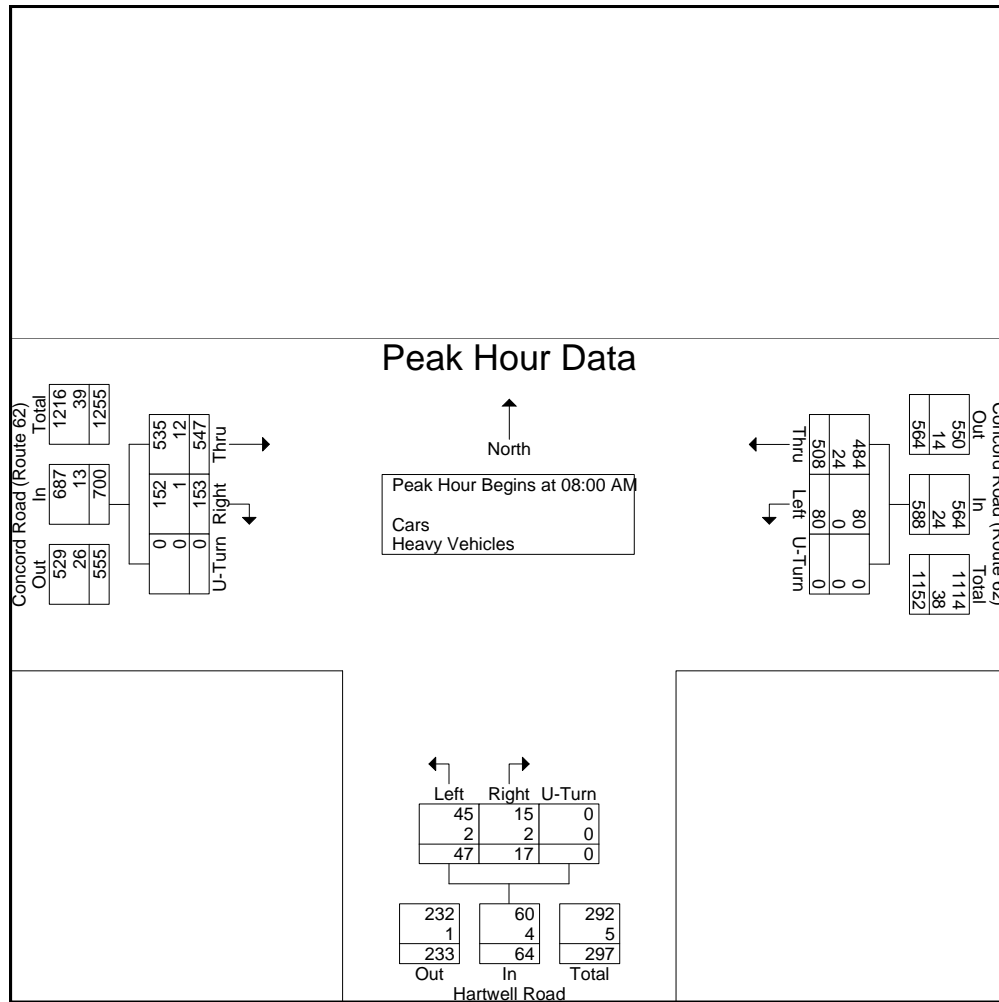
	Concord Road (Route 62) From East				Hartwell Road From South				Concord Road (Route 62) From West				
Start Time	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 06:15 AM													
06:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
06:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
07:00 AM	1	0	0	1	0	0	0	0	0	1	0	1	2
Total Volume	1	0	0	1	0	0	0	0	0	1	0	1	2
% App. Total	100	0	0		0	0	0		0	100	0		
PHF	.250	.000	.000	.250	.000	.000	.000	.000	.000	.250	.000	.250	.250

S: Hartwell Road
 E/W: Concord Road (Route 62)
 City, State: Bedford, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 L
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

	Concord Road (Route 62) From East				Hartwell Road From South				Concord Road (Route 62) From West				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 08:00 AM													
08:00 AM	120	30	0	150	2	11	0	13	43	124	0	167	330
08:15 AM	109	27	0	136	3	13	0	16	44	141	0	185	337
08:30 AM	131	12	0	143	9	9	0	18	28	124	0	152	313
08:45 AM	148	11	0	159	3	14	0	17	38	158	0	196	372
Total Volume	508	80	0	588	17	47	0	64	153	547	0	700	1352
% App. Total	86.4	13.6	0		26.6	73.4	0		21.9	78.1	0		
PHF	.858	.667	.000	.925	.472	.839	.000	.889	.869	.866	.000	.893	.909
Cars	484	80	0	564	15	45	0	60	152	535	0	687	1311
% Cars	95.3	100	0	95.9	88.2	95.7	0	93.8	99.3	97.8	0	98.1	97.0
Heavy Vehicles	24	0	0	24	2	2	0	4	1	12	0	13	41
% Heavy Vehicles	4.7	0	0	4.1	11.8	4.3	0	6.3	0.7	2.2	0	1.9	3.0





PRECISION
D A T A
INDUSTRIES, LLC

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N/S: South Road
W: Hartwell Road
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 M
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	South Road From North			South Road From South			Hartwell Road From West			
Start Time	Right	Thru	U-Turn	Thru	Left	U-Turn	Right	Left	U-Turn	Int. Total
06:00 AM	5	26	0	29	1	0	2	0	0	63
06:15 AM	6	64	0	11	10	0	4	1	0	96
06:30 AM	12	67	0	21	11	0	7	7	0	125
06:45 AM	10	130	0	28	8	0	9	11	0	196
Total	33	287	0	89	30	0	22	19	0	480
07:00 AM	13	118	0	28	18	0	12	8	0	197
07:15 AM	7	125	0	54	12	0	15	9	0	222
07:30 AM	11	161	0	47	15	0	22	33	0	289
07:45 AM	16	169	0	45	23	0	40	13	0	306
Total	47	573	0	174	68	0	89	63	0	1014
08:00 AM	13	171	0	27	14	0	37	21	0	283
08:15 AM	12	134	0	31	15	0	29	19	0	240
08:30 AM	8	125	0	28	17	0	14	20	0	212
08:45 AM	14	115	0	34	18	0	20	17	0	218
Total	47	545	0	120	64	0	100	77	0	953
Grand Total	127	1405	0	383	162	0	211	159	0	2447
Apprch %	8.3	91.7	0	70.3	29.7	0	57	43	0	
Total %	5.2	57.4	0	15.7	6.6	0	8.6	6.5	0	
Cars	122	1379	0	355	151	0	200	155	0	2362
% Cars	96.1	98.1	0	92.7	93.2	0	94.8	97.5	0	96.5
Heavy Vehicles	5	26	0	28	11	0	11	4	0	85
% Heavy Vehicles	3.9	1.9	0	7.3	6.8	0	5.2	2.5	0	3.5

	South Road From North				South Road From South				Hartwell Road From West				
Start Time	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:30 AM													
07:30 AM	11	161	0	172	47	15	0	62	22	33	0	55	289
07:45 AM	16	169	0	185	45	23	0	68	40	13	0	53	306
08:00 AM	13	171	0	184	27	14	0	41	37	21	0	58	283
08:15 AM	12	134	0	146	31	15	0	46	29	19	0	48	240
Total Volume	52	635	0	687	150	67	0	217	128	86	0	214	1118
% App. Total	7.6	92.4	0		69.1	30.9	0		59.8	40.2	0		
PHF	.813	.928	.000	.928	.798	.728	.000	.798	.800	.652	.000	.922	.913
Cars	50	627	0	677	137	59	0	196	119	86	0	205	1078
% Cars	96.2	98.7	0	98.5	91.3	88.1	0	90.3	93.0	100	0	95.8	96.4
Heavy Vehicles	2	8	0	10	13	8	0	21	9	0	0	9	40
% Heavy Vehicles	3.8	1.3	0	1.5	8.7	11.9	0	9.7	7.0	0	0	4.2	3.6



PRECISION
D A T A
INDUSTRIES, LLC

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N/S: South Road
W: Hartwell Road
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 M
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars

Start Time	South Road From North			South Road From South			Hartwell Road From West			Int. Total
	Right	Thru	U-Turn	Thru	Left	U-Turn	Right	Left	U-Turn	
06:00 AM	5	24	0	28	1	0	2	0	0	60
06:15 AM	6	64	0	9	10	0	4	1	0	94
06:30 AM	12	65	0	21	11	0	7	7	0	123
06:45 AM	9	127	0	26	8	0	9	11	0	190
Total	32	280	0	84	30	0	22	19	0	467
07:00 AM	13	117	0	27	18	0	12	8	0	195
07:15 AM	7	124	0	48	10	0	15	8	0	212
07:30 AM	11	158	0	46	13	0	21	33	0	282
07:45 AM	15	169	0	43	20	0	36	13	0	296
Total	46	568	0	164	61	0	84	62	0	985
08:00 AM	12	168	0	21	13	0	35	21	0	270
08:15 AM	12	132	0	27	13	0	27	19	0	230
08:30 AM	7	120	0	27	17	0	13	20	0	204
08:45 AM	13	111	0	32	17	0	19	14	0	206
Total	44	531	0	107	60	0	94	74	0	910
Grand Total	122	1379	0	355	151	0	200	155	0	2362
Apprch %	8.1	91.9	0	70.2	29.8	0	56.3	43.7	0	
Total %	5.2	58.4	0	15	6.4	0	8.5	6.6	0	

	South Road From North				South Road From South				Hartwell Road From West				
Start Time	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:30 AM													
07:30 AM	11	158	0	169	46	13	0	59	21	33	0	54	282
07:45 AM	15	169	0	184	43	20	0	63	36	13	0	49	296
08:00 AM	12	168	0	180	21	13	0	34	35	21	0	56	270
08:15 AM	12	132	0	144	27	13	0	40	27	19	0	46	230
Total Volume	50	627	0	677	137	59	0	196	119	86	0	205	1078
% App. Total	7.4	92.6	0		69.9	30.1	0		58	42	0		
PHF	.833	.928	.000	.920	.745	.738	.000	.778	.826	.652	.000	.915	.910



PRECISION
D A T A
INDUSTRIES, LLC

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N/S: South Road
W: Hartwell Road
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 M
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

Start Time	South Road From North			South Road From South			Hartwell Road From West			Int. Total
	Right	Thru	U-Turn	Thru	Left	U-Turn	Right	Left	U-Turn	
06:00 AM	0	2	0	1	0	0	0	0	0	3
06:15 AM	0	0	0	2	0	0	0	0	0	2
06:30 AM	0	2	0	0	0	0	0	0	0	2
06:45 AM	1	3	0	2	0	0	0	0	0	6
Total	1	7	0	5	0	0	0	0	0	13
07:00 AM	0	1	0	1	0	0	0	0	0	2
07:15 AM	0	1	0	6	2	0	0	1	0	10
07:30 AM	0	3	0	1	2	0	1	0	0	7
07:45 AM	1	0	0	2	3	0	4	0	0	10
Total	1	5	0	10	7	0	5	1	0	29
08:00 AM	1	3	0	6	1	0	2	0	0	13
08:15 AM	0	2	0	4	2	0	2	0	0	10
08:30 AM	1	5	0	1	0	0	1	0	0	8
08:45 AM	1	4	0	2	1	0	1	3	0	12
Total	3	14	0	13	4	0	6	3	0	43
Grand Total	5	26	0	28	11	0	11	4	0	85
Apprch %	16.1	83.9	0	71.8	28.2	0	73.3	26.7	0	
Total %	5.9	30.6	0	32.9	12.9	0	12.9	4.7	0	

	South Road From North				South Road From South				Hartwell Road From West				
Start Time	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 08:00 AM													
08:00 AM	1	3	0	4	6	1	0	7	2	0	0	2	13
08:15 AM	0	2	0	2	4	2	0	6	2	0	0	2	10
08:30 AM	1	5	0	6	1	0	0	1	1	0	0	1	8
08:45 AM	1	4	0	5	2	1	0	3	1	3	0	4	12
Total Volume	3	14	0	17	13	4	0	17	6	3	0	9	43
% App. Total	17.6	82.4	0		76.5	23.5	0		66.7	33.3	0		
PHF	.750	.700	.000	.708	.542	.500	.000	.607	.750	.250	.000	.563	.827



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
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N/S: South Road
W: Hartwell Road
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 M
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

	South Road From North			South Road From South			Hartwell Road From West			
Start Time	Right	Thru	Peds	Thru	Left	Peds	Right	Left	Peds	Int. Total
06:00 AM	0	0	0	0	0	0	0	0	0	0
06:15 AM	0	0	0	4	0	0	0	0	0	4
06:30 AM	0	0	0	0	0	0	0	0	0	0
06:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	4	0	0	0	0	0	4
07:00 AM	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	2	0	0	0	0	0	0	2
07:30 AM	0	0	0	0	0	0	0	1	0	1
07:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	0	2	0	0	0	0	1	0	3
08:00 AM	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	2	4	0	0	0	1	0	7
Apprch %	0	0	100	100	0	0	0	100	0	
Total %	0	0	28.6	57.1	0	0	0	14.3	0	

	South Road From North				South Road From South				Hartwell Road From West				
Start Time	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 06:00 AM													
06:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
06:15 AM	0	0	0	0	4	0	0	4	0	0	0	0	4
06:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	4	0	0	4	0	0	0	0	4
% App. Total	0	0	0		100	0	0		0	0	0		
PHF	.000	.000	.000	.000	.250	.000	.000	.250	.000	.000	.000	.000	.250



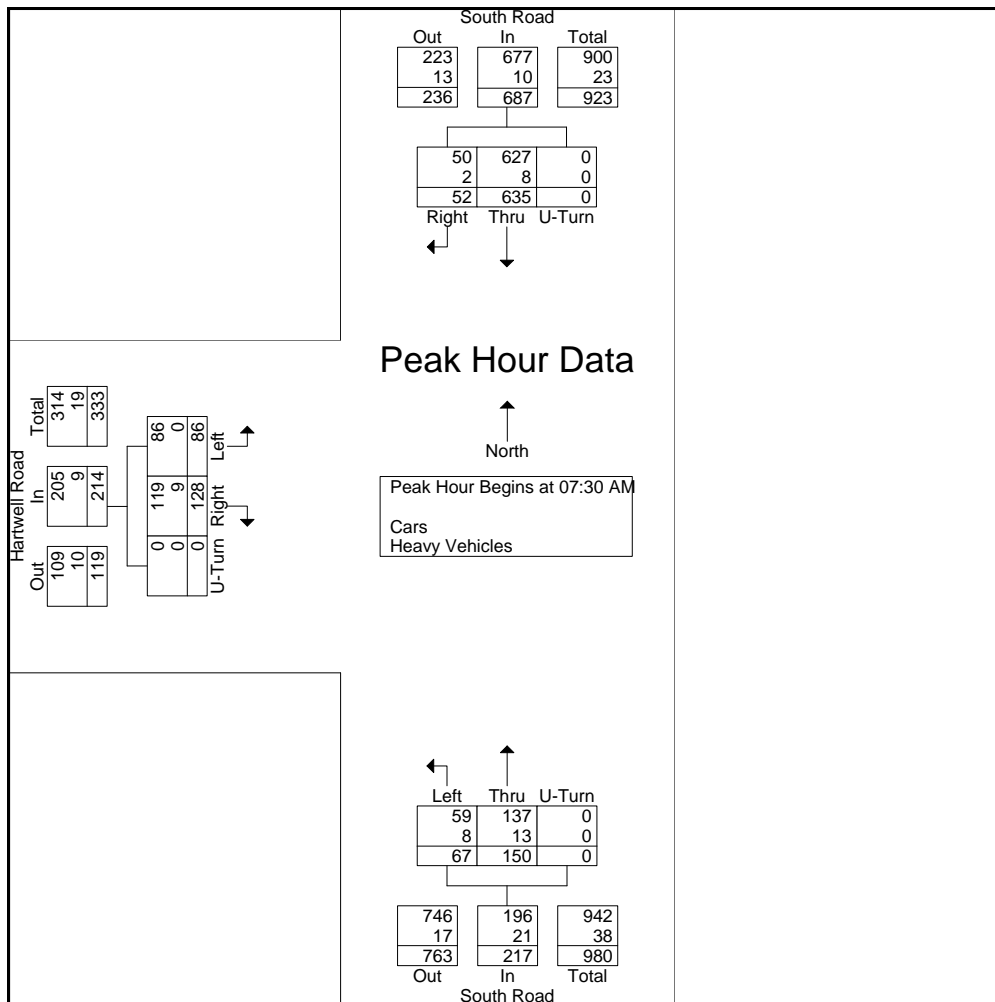
PRECISION
D A T A
INDUSTRIES, LLC

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N/S: South Road
W: Hartwell Road
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 M
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

	South Road From North				South Road From South				Hartwell Road From West				
Start Time	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:30 AM													
07:30 AM	11	161	0	172	47	15	0	62	22	33	0	55	289
07:45 AM	16	169	0	185	45	23	0	68	40	13	0	53	306
08:00 AM	13	171	0	184	27	14	0	41	37	21	0	58	283
08:15 AM	12	134	0	146	31	15	0	46	29	19	0	48	240
Total Volume	52	635	0	687	150	67	0	217	128	86	0	214	1118
% App. Total	7.6	92.4	0		69.1	30.9	0		59.8	40.2	0		
PHF	.813	.928	.000	.928	.798	.728	.000	.798	.800	.652	.000	.922	.913
Cars	50	627	0	677	137	59	0	196	119	86	0	205	1078
% Cars	96.2	98.7	0	98.5	91.3	88.1	0	90.3	93.0	100	0	95.8	96.4
Heavy Vehicles	2	8	0	10	13	8	0	21	9	0	0	9	40
% Heavy Vehicles	3.8	1.3	0	1.5	8.7	11.9	0	9.7	7.0	0	0	4.2	3.6



N: North Road (Route 4/225)
 E/W: Great Rd (4/225)/ Concord Rd (62)
 City, State: Bedford, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 N
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

Groups Printed- Cars - Heavy Vehicles

	North Road (Route 4/225) From North			Great Road (Route 4/225) From East			Concord Road (Route 62) From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
06:00 AM	33	109	0	17	15	0	25	10	0	209
06:15 AM	44	169	0	23	11	0	39	11	0	297
06:30 AM	57	187	0	39	24	0	36	13	0	356
06:45 AM	91	264	0	53	33	0	44	21	0	506
Total	225	729	0	132	83	0	144	55	0	1368
07:00 AM	91	189	0	55	37	0	63	32	0	467
07:15 AM	118	169	0	48	42	0	49	42	0	468
07:30 AM	140	141	0	81	78	0	68	60	0	568
07:45 AM	111	158	0	73	64	0	76	49	0	531
Total	460	657	0	257	221	0	256	183	0	2034
08:00 AM	104	152	0	56	55	0	87	38	0	492
08:15 AM	96	162	0	68	72	0	83	57	0	538
08:30 AM	100	140	0	62	77	0	79	53	0	511
08:45 AM	119	163	0	74	88	0	80	38	0	562
Total	419	617	0	260	292	0	329	186	0	2103
Grand Total	1104	2003	0	649	596	0	729	424	0	5505
Apprch %	35.5	64.5	0	52.1	47.9	0	63.2	36.8	0	
Total %	20.1	36.4	0	11.8	10.8	0	13.2	7.7	0	
Cars	1078	1970	0	592	567	0	708	417	0	5332
% Cars	97.6	98.4	0	91.2	95.1	0	97.1	98.3	0	96.9
Heavy Vehicles	26	33	0	57	29	0	21	7	0	173
% Heavy Vehicles	2.4	1.6	0	8.8	4.9	0	2.9	1.7	0	3.1

	North Road (Route 4/225) From North				Great Road (Route 4/225) From East				Concord Road (Route 62) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:30 AM													
07:30 AM	140	141	0	281	81	78	0	159	68	60	0	128	568
07:45 AM	111	158	0	269	73	64	0	137	76	49	0	125	531
08:00 AM	104	152	0	256	56	55	0	111	87	38	0	125	492
08:15 AM	96	162	0	258	68	72	0	140	83	57	0	140	538
Total Volume	451	613	0	1064	278	269	0	547	314	204	0	518	2129
% App. Total	42.4	57.6	0		50.8	49.2	0		60.6	39.4	0		
PHF	.805	.946	.000	.947	.858	.862	.000	.860	.902	.850	.000	.925	.937
Cars	442	606	0	1048	258	260	0	518	306	199	0	505	2071
% Cars	98.0	98.9	0	98.5	92.8	96.7	0	94.7	97.5	97.5	0	97.5	97.3
Heavy Vehicles	9	7	0	16	20	9	0	29	8	5	0	13	58
% Heavy Vehicles	2.0	1.1	0	1.5	7.2	3.3	0	5.3	2.5	2.5	0	2.5	2.7



PRECISION
D A T A
INDUSTRIES, LLC

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N: North Road (Route 4/225)
E/W: Great Rd (4/225)/ Concord Rd (62)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 N
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars

	North Road (Route 4/225) From North			Great Road (Route 4/225) From East			Concord Road (Route 62) From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
06:00 AM	33	107	0	16	15	0	25	10	0	206
06:15 AM	44	165	0	23	11	0	37	11	0	291
06:30 AM	56	186	0	35	24	0	36	13	0	350
06:45 AM	91	262	0	46	29	0	43	21	0	492
Total	224	720	0	120	79	0	141	55	0	1339
07:00 AM	88	187	0	45	35	0	62	30	0	447
07:15 AM	113	165	0	47	40	0	47	42	0	454
07:30 AM	138	140	0	79	76	0	65	60	0	558
07:45 AM	109	156	0	70	63	0	75	49	0	522
Total	448	648	0	241	214	0	249	181	0	1981
08:00 AM	102	152	0	50	54	0	86	38	0	482
08:15 AM	93	158	0	59	67	0	80	52	0	509
08:30 AM	95	133	0	60	71	0	77	53	0	489
08:45 AM	116	159	0	62	82	0	75	38	0	532
Total	406	602	0	231	274	0	318	181	0	2012
Grand Total	1078	1970	0	592	567	0	708	417	0	5332
Apprch %	35.4	64.6	0	51.1	48.9	0	62.9	37.1	0	
Total %	20.2	36.9	0	11.1	10.6	0	13.3	7.8	0	

	North Road (Route 4/225) From North				Great Road (Route 4/225) From East				Concord Road (Route 62) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:30 AM													
07:30 AM	138	140	0	278	79	76	0	155	65	60	0	125	558
07:45 AM	109	156	0	265	70	63	0	133	75	49	0	124	522
08:00 AM	102	152	0	254	50	54	0	104	86	38	0	124	482
08:15 AM	93	158	0	251	59	67	0	126	80	52	0	132	509
Total Volume	442	606	0	1048	258	260	0	518	306	199	0	505	2071
% App. Total	42.2	57.8	0		49.8	50.2	0		60.6	39.4	0		
PHF	.801	.959	.000	.942	.816	.855	.000	.835	.890	.829	.000	.956	.928



PRECISION
D A T A
INDUSTRIES, LLC

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N: North Road (Route 4/225)
E/W: Great Rd (4/225)/ Concord Rd (62)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 N
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

	North Road (Route 4/225) From North			Great Road (Route 4/225) From East			Concord Road (Route 62) From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
06:00 AM	0	2	0	1	0	0	0	0	0	3
06:15 AM	0	4	0	0	0	0	2	0	0	6
06:30 AM	1	1	0	4	0	0	0	0	0	6
06:45 AM	0	2	0	7	4	0	1	0	0	14
Total	1	9	0	12	4	0	3	0	0	29
07:00 AM	3	2	0	10	2	0	1	2	0	20
07:15 AM	5	4	0	1	2	0	2	0	0	14
07:30 AM	2	1	0	2	2	0	3	0	0	10
07:45 AM	2	2	0	3	1	0	1	0	0	9
Total	12	9	0	16	7	0	7	2	0	53
08:00 AM	2	0	0	6	1	0	1	0	0	10
08:15 AM	3	4	0	9	5	0	3	5	0	29
08:30 AM	5	7	0	2	6	0	2	0	0	22
08:45 AM	3	4	0	12	6	0	5	0	0	30
Total	13	15	0	29	18	0	11	5	0	91
Grand Total	26	33	0	57	29	0	21	7	0	173
Apprch %	44.1	55.9	0	66.3	33.7	0	75	25	0	
Total %	15	19.1	0	32.9	16.8	0	12.1	4	0	

	North Road (Route 4/225) From North				Great Road (Route 4/225) From East				Concord Road (Route 62) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 08:00 AM													
08:00 AM	2	0	0	2	6	1	0	7	1	0	0	1	10
08:15 AM	3	4	0	7	9	5	0	14	3	5	0	8	29
08:30 AM	5	7	0	12	2	6	0	8	2	0	0	2	22
08:45 AM	3	4	0	7	12	6	0	18	5	0	0	5	30
Total Volume	13	15	0	28	29	18	0	47	11	5	0	16	91
% App. Total	46.4	53.6	0		61.7	38.3	0		68.8	31.2	0		
PHF	.650	.536	.000	.583	.604	.750	.000	.653	.550	.250	.000	.500	.758



N: North Road (Route 4/225)
E/W: Great Rd (4/225)/ Concord Rd (62)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 N
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

	North Road (Route 4/225) From North			Great Road (Route 4/225) From East			Concord Road (Route 62) From West			
Start Time	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	Int. Total
06:00 AM	0	0	0	0	0	0	0	0	0	0
06:15 AM	0	0	0	0	0	0	0	0	0	0
06:30 AM	0	1	0	0	0	0	0	0	0	1
06:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	1	0	0	0	0	0	0	0	1
07:00 AM	1	0	0	0	0	0	0	0	0	1
07:15 AM	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0
Total	1	0	0	0	0	0	0	0	0	1
08:00 AM	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0
Grand Total	1	1	0	0	0	0	0	0	0	2
Apprch %	50	50	0	0	0	0	0	0	0	
Total %	50	50	0	0	0	0	0	0	0	

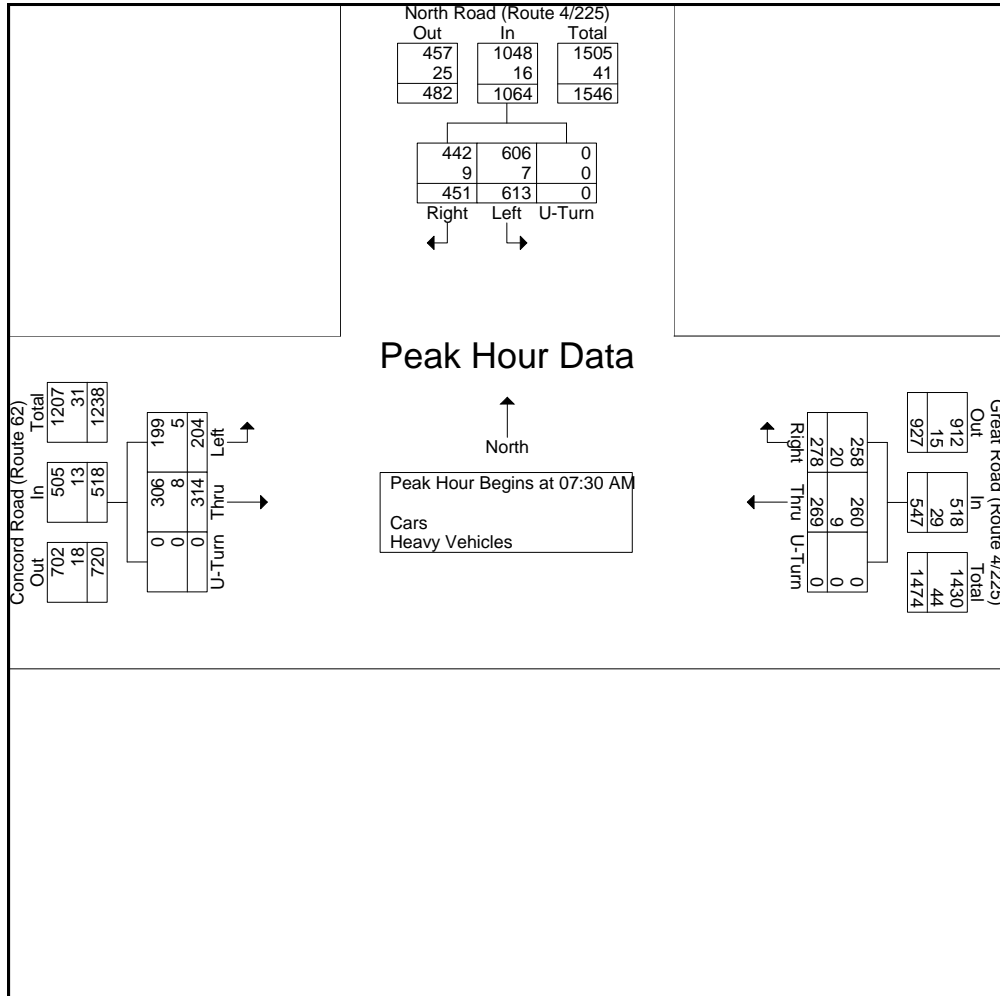
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N: North Road (Route 4/225)
 E/W: Great Rd (4/225)/ Concord Rd (62)
 City, State: Bedford, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 N
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

	North Road (Route 4/225)				Great Road (Route 4/225)				Concord Road (Route 62)				
	From North				From East				From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:30 AM													
07:30 AM	140	141	0	281	81	78	0	159	68	60	0	128	568
07:45 AM	111	158	0	269	73	64	0	137	76	49	0	125	531
08:00 AM	104	152	0	256	56	55	0	111	87	38	0	125	492
08:15 AM	96	162	0	258	68	72	0	140	83	57	0	140	538
Total Volume	451	613	0	1064	278	269	0	547	314	204	0	518	2129
% App. Total	42.4	57.6	0		50.8	49.2	0		60.6	39.4	0		
PHF	.805	.946	.000	.947	.858	.862	.000	.860	.902	.850	.000	.925	.937
Cars	442	606	0	1048	258	260	0	518	306	199	0	505	2071
% Cars	98.0	98.9	0	98.5	92.8	96.7	0	94.7	97.5	97.5	0	97.5	97.3
Heavy Vehicles	9	7	0	16	20	9	0	29	8	5	0	13	58
% Heavy Vehicles	2.0	1.1	0	1.5	7.2	3.3	0	5.3	2.5	2.5	0	2.5	2.7





PRECISION
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N/S: Springs Road/ South Road
E/W: Great Road (Route 4/62/225)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 O
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Springs Road From North				Great Road (Route 4/62/225) From East				South Road From South				Great Road (Route 4/62/225) From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
06:00 AM	3	1	4	0	1	28	1	0	0	0	3	0	29	91	3	0	164
06:15 AM	6	6	2	0	0	21	1	0	1	0	6	0	55	144	4	0	246
06:30 AM	7	9	8	0	1	61	1	0	5	1	8	0	47	162	9	0	319
06:45 AM	5	51	25	0	3	73	0	0	1	2	15	0	46	200	13	0	434
Total	21	67	39	0	5	183	3	0	7	3	32	0	177	597	29	0	1163
07:00 AM	8	61	24	0	1	86	0	0	3	6	16	0	37	176	17	0	435
07:15 AM	13	77	25	0	3	84	0	0	4	16	26	0	15	162	23	0	448
07:30 AM	13	80	25	0	4	140	1	0	15	28	47	0	19	173	14	0	559
07:45 AM	17	92	27	0	3	97	1	0	17	14	30	0	14	182	15	0	509
Total	51	310	101	0	11	407	2	0	39	64	119	0	85	693	69	0	1951
08:00 AM	15	88	34	0	2	94	2	0	6	9	19	0	17	180	16	0	482
08:15 AM	14	54	37	0	3	112	0	0	7	6	26	0	19	171	21	0	470
08:30 AM	14	48	30	0	1	111	1	0	11	11	20	0	25	163	24	0	459
08:45 AM	34	51	27	0	2	112	1	0	8	8	23	0	25	163	14	0	468
Total	77	241	128	0	8	429	4	0	32	34	88	0	86	677	75	0	1879
Grand Total	149	618	268	0	24	1019	9	0	78	101	239	0	348	1967	173	0	4993
Apprch %	14.4	59.7	25.9	0	2.3	96.9	0.9	0	18.7	24.2	57.2	0	14	79.1	7	0	
Total %	3	12.4	5.4	0	0.5	20.4	0.2	0	1.6	2	4.8	0	7	39.4	3.5	0	
Cars	142	611	266	0	22	958	8	0	77	92	217	0	342	1929	172	0	4836
% Cars	95.3	98.9	99.3	0	91.7	94	88.9	0	98.7	91.1	90.8	0	98.3	98.1	99.4	0	96.9
Heavy Vehicles	7	7	2	0	2	61	1	0	1	9	22	0	6	38	1	0	157
% Heavy Vehicles	4.7	1.1	0.7	0	8.3	6	11.1	0	1.3	8.9	9.2	0	1.7	1.9	0.6	0	3.1

	Springs Road From North					Great Road (Route 4/62/225) From East					South Road From South					Great Road (Route 4/62/225) From West					Int. Total
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
07:30 AM	13	80	25	0	118	4	140	1	0	145	15	28	47	0	90	19	173	14	0	206	559
07:45 AM	17	92	27	0	136	3	97	1	0	101	17	14	30	0	61	14	182	15	0	211	509
08:00 AM	15	88	34	0	137	2	94	2	0	98	6	9	19	0	34	17	180	16	0	213	482
08:15 AM	14	54	37	0	105	3	112	0	0	115	7	6	26	0	39	19	171	21	0	211	470
Total Volume	59	314	123	0	496	12	443	4	0	459	45	57	122	0	224	69	706	66	0	841	2020
% App. Total	11.9	63.3	24.8	0		2.6	96.5	0.9	0		20.1	25.4	54.5	0		8.2	83.9	7.8	0		
PHF	.868	.853	.831	.000	.905	.750	.791	.500	.000	.791	.662	.509	.649	.000	.622	.908	.970	.786	.000	.987	.903
Cars	58	313	122	0	493	12	417	4	0	433	44	53	114	0	211	67	699	66	0	832	1969
% Cars	98.3	99.7	99.2	0	99.4	100	94.1	100	0	94.3	97.8	93.0	93.4	0	94.2	97.1	99.0	100	0	98.9	97.5
Heavy Vehicles	1	1	1	0	3	0	26	0	0	26	1	4	8	0	13	2	7	0	0	9	51
% Heavy Vehicles	1.7	0.3	0.8	0	0.6	0	5.9	0	0	5.7	2.2	7.0	6.6	0	5.8	2.9	1.0	0	0	1.1	2.5

Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1

Peak Hour for Entire Intersection Begins at 07:30 AM



PRECISION
D A T A
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N/S: Springs Road/ South Road
E/W: Great Road (Route 4/62/225)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 O
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars

	Springs Road From North				Great Road (Route 4/62/225) From East				South Road From South				Great Road (Route 4/62/225) From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
06:00 AM	3	1	4	0	1	27	0	0	0	0	3	0	29	91	3	0	162
06:15 AM	6	6	2	0	0	21	1	0	1	0	6	0	55	138	4	0	240
06:30 AM	7	9	8	0	1	57	1	0	5	1	7	0	47	161	9	0	313
06:45 AM	5	50	25	0	3	68	0	0	1	1	12	0	46	198	13	0	422
Total	21	66	39	0	5	173	2	0	7	2	28	0	177	588	29	0	1137
07:00 AM	8	61	24	0	0	78	0	0	3	3	11	0	37	172	17	0	414
07:15 AM	13	74	25	0	2	81	0	0	4	16	24	0	15	157	23	0	434
07:30 AM	12	80	24	0	4	138	1	0	15	27	45	0	18	171	14	0	549
07:45 AM	17	92	27	0	3	92	1	0	17	14	29	0	14	180	15	0	501
Total	50	307	100	0	9	389	2	0	39	60	109	0	84	680	69	0	1898
08:00 AM	15	87	34	0	2	89	2	0	6	8	18	0	17	178	16	0	472
08:15 AM	14	54	37	0	3	98	0	0	6	4	22	0	18	170	21	0	447
08:30 AM	14	46	29	0	1	107	1	0	11	10	19	0	22	159	23	0	442
08:45 AM	28	51	27	0	2	102	1	0	8	8	21	0	24	154	14	0	440
Total	71	238	127	0	8	396	4	0	31	30	80	0	81	661	74	0	1801
Grand Total	142	611	266	0	22	958	8	0	77	92	217	0	342	1929	172	0	4836
Apprch %	13.9	60	26.1	0	2.2	97	0.8	0	19.9	23.8	56.2	0	14	79	7	0	
Total %	2.9	12.6	5.5	0	0.5	19.8	0.2	0	1.6	1.9	4.5	0	7.1	39.9	3.6	0	

	Springs Road From North					Great Road (Route 4/62/225) From East					South Road From South					Great Road (Route 4/62/225) From West					Int. Total
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	12	80	24	0	116	4	138	1	0	143	15	27	45	0	87	18	171	14	0	203	549
07:45 AM	17	92	27	0	136	3	92	1	0	96	17	14	29	0	60	14	180	15	0	209	501
08:00 AM	15	87	34	0	136	2	89	2	0	93	6	8	18	0	32	17	178	16	0	211	472
08:15 AM	14	54	37	0	105	3	98	0	0	101	6	4	22	0	32	18	170	21	0	209	447
Total Volume	58	313	122	0	493	12	417	4	0	433	44	53	114	0	211	67	699	66	0	832	1969
% App. Total	11.8	63.5	24.7	0		2.8	96.3	0.9	0		20.9	25.1	54	0		8.1	84	7.9	0		
PHF	.853	.851	.824	.000	.906	.750	.755	.500	.000	.757	.647	.491	.633	.000	.606	.931	.971	.786	.000	.986	.897



PRECISION
D A T A
INDUSTRIES, LLC

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N/S: Springs Road/ South Road
E/W: Great Road (Route 4/62/225)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 O
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

	Springs Road From North				Great Road (Route 4/62/225) From East				South Road From South				Great Road (Route 4/62/225) From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
06:00 AM	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	2
06:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	6
06:30 AM	0	0	0	0	0	4	0	0	0	0	1	0	0	1	0	0	6
06:45 AM	0	1	0	0	0	5	0	0	0	1	3	0	0	2	0	0	12
Total	0	1	0	0	0	10	1	0	0	1	4	0	0	9	0	0	26
07:00 AM	0	0	0	0	1	8	0	0	0	3	5	0	0	4	0	0	21
07:15 AM	0	3	0	0	1	3	0	0	0	0	2	0	0	5	0	0	14
07:30 AM	1	0	1	0	0	2	0	0	0	1	2	0	1	2	0	0	10
07:45 AM	0	0	0	0	0	5	0	0	0	0	1	0	0	2	0	0	8
Total	1	3	1	0	2	18	0	0	0	4	10	0	1	13	0	0	53
08:00 AM	0	1	0	0	0	5	0	0	0	1	1	0	0	2	0	0	10
08:15 AM	0	0	0	0	0	14	0	0	1	2	4	0	1	1	0	0	23
08:30 AM	0	2	1	0	0	4	0	0	0	1	1	0	3	4	1	0	17
08:45 AM	6	0	0	0	0	10	0	0	0	0	2	0	1	9	0	0	28
Total	6	3	1	0	0	33	0	0	1	4	8	0	5	16	1	0	78
Grand Total	7	7	2	0	2	61	1	0	1	9	22	0	6	38	1	0	157
Apprch %	43.8	43.8	12.5	0	3.1	95.3	1.6	0	3.1	28.1	68.8	0	13.3	84.4	2.2	0	
Total %	4.5	4.5	1.3	0	1.3	38.9	0.6	0	0.6	5.7	14	0	3.8	24.2	0.6	0	

	Springs Road From North					Great Road (Route 4/62/225) From East					South Road From South					Great Road (Route 4/62/225) From West					Int. Total
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 08:00 AM																					
08:00 AM	0	1	0	0	1	0	5	0	0	5	0	1	1	0	2	0	2	0	0	2	10
08:15 AM	0	0	0	0	0	0	14	0	0	14	1	2	4	0	7	1	1	0	0	2	23
08:30 AM	0	2	1	0	3	0	4	0	0	4	0	1	1	0	2	3	4	1	0	8	17
08:45 AM	6	0	0	0	6	0	10	0	0	10	0	0	2	0	2	1	9	0	0	10	28
Total Volume	6	3	1	0	10	0	33	0	0	33	1	4	8	0	13	5	16	1	0	22	78
% App. Total	60	30	10	0		0	100	0	0		7.7	30.8	61.5	0		22.7	72.7	4.5	0		
PHF	.250	.375	.250	.000	.417	.000	.589	.000	.000	.589	.250	.500	.500	.000	.464	.417	.444	.250	.000	.550	.696



PRECISION
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N/S: Springs Road/ South Road
E/W: Great Road (Route 4/62/225)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 O
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

	Springs Road From North				Great Road (Route 4/62/225) From East				South Road From South				Great Road (Route 4/62/225) From West				Int. Total
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	
06:00 AM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2
06:15 AM	0	0	0	2	0	0	0	2	0	0	0	2	0	0	0	0	6
06:30 AM	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	4
06:45 AM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	2
Total	0	0	0	3	0	0	0	2	0	4	0	3	0	0	0	2	14
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	2	0	0	0	1	0	0	0	1	0	0	0	0	4
07:30 AM	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	2
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	2	0	0	0	2	0	0	0	2	0	0	0	0	6
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
08:30 AM	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	3
Grand Total	0	0	0	5	0	0	0	6	0	4	0	6	0	0	0	2	23
Apprch %	0	0	0	100	0	0	0	100	0	40	0	60	0	0	0	100	
Total %	0	0	0	21.7	0	0	0	26.1	0	17.4	0	26.1	0	0	0	8.7	

	Springs Road From North					Great Road (Route 4/62/225) From East					South Road From South					Great Road (Route 4/62/225) From West					Int. Total
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
06:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	2
06:15 AM	0	0	0	2	2	0	0	0	2	2	0	0	0	2	2	0	0	0	0	0	6
06:30 AM	0	0	0	0	0	0	0	0	0	0	0	4	0	0	4	0	0	0	0	0	4
06:45 AM	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2
Total Volume	0	0	0	3	3	0	0	0	2	2	0	4	0	3	7	0	0	0	2	2	14
% App. Total	0	0	0	100		0	0	0	100		0	57.1	0	42.9		0	0	0	100		
PHF	.000	.000	.000	.375	.375	.000	.000	.000	.250	.250	.000	.250	.000	.375	.438	.000	.000	.000	.500	.500	.583

Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1

Peak Hour for Entire Intersection Begins at 06:00 AM



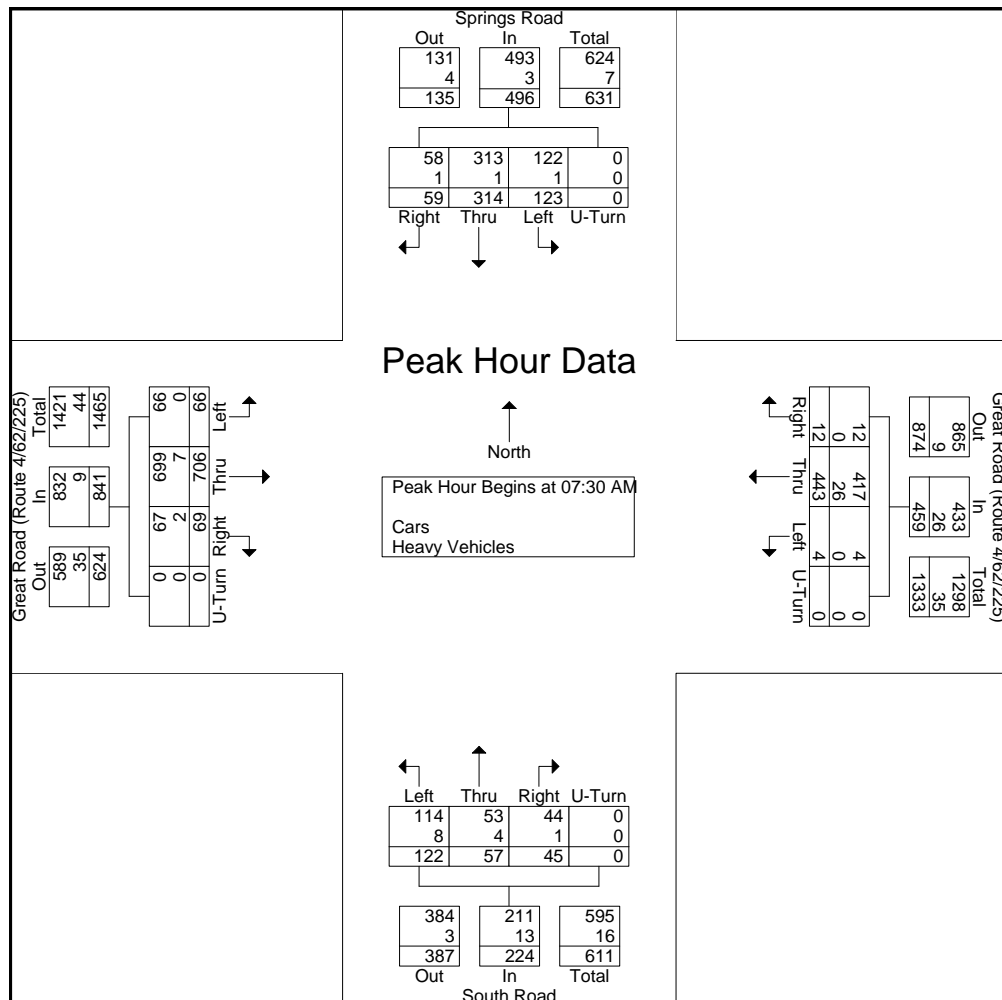
PRECISION
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N/S: Springs Road/ South Road
E/W: Great Road (Route 4/62/225)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 O
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

	Springs Road From North					Great Road (Route 4/62/225) From East					South Road From South					Great Road (Route 4/62/225) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	13	80	25	0	118	4	140	1	0	145	15	28	47	0	90	19	173	14	0	206	559
07:45 AM	17	92	27	0	136	3	97	1	0	101	17	14	30	0	61	14	182	15	0	211	509
08:00 AM	15	88	34	0	137	2	94	2	0	98	6	9	19	0	34	17	180	16	0	213	482
08:15 AM	14	54	37	0	105	3	112	0	0	115	7	6	26	0	39	19	171	21	0	211	470
Total Volume	59	314	123	0	496	12	443	4	0	459	45	57	122	0	224	69	706	66	0	841	2020
% App. Total	11.9	63.3	24.8	0		2.6	96.5	0.9	0		20.1	25.4	54.5	0		8.2	83.9	7.8	0		
PHF	.868	.853	.831	.000	.905	.750	.791	.500	.000	.791	.662	.509	.649	.000	.622	.908	.970	.786	.000	.987	.903
Cars	58	313	122	0	493	12	417	4	0	433	44	53	114	0	211	67	699	66	0	832	1969
% Cars	98.3	99.7	99.2	0	99.4	100	94.1	100	0	94.3	97.8	93.0	93.4	0	94.2	97.1	99.0	100	0	98.9	97.5
Heavy Vehicles	1	1	1	0	3	0	26	0	0	26	1	4	8	0	13	2	7	0	0	9	51
% Heavy Vehicles	1.7	0.3	0.8	0	0.6	0	5.9	0	0	5.7	2.2	7.0	6.6	0	5.8	2.9	1.0	0	0	1.1	2.5





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N/S: South Road
E/W: Loomis Street/ Railroad Avenue
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 P
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	South Road From North				Loomis Street From East				South Road From South				Railroad Avenue From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
06:00 AM	2	23	3	0	0	3	14	0	7	3	1	0	2	7	0	0	65
06:15 AM	7	58	4	0	0	6	12	0	3	6	2	0	1	3	1	0	103
06:30 AM	2	60	1	0	1	3	22	0	15	12	3	0	3	4	0	0	126
06:45 AM	9	110	5	0	1	13	22	0	15	17	7	0	6	15	3	0	223
Total	20	251	13	0	2	25	70	0	40	38	13	0	12	29	4	0	517
07:00 AM	10	106	2	0	1	24	24	0	19	9	10	0	8	18	7	0	238
07:15 AM	14	103	2	0	0	37	19	0	20	28	18	0	14	36	8	0	299
07:30 AM	24	117	8	0	3	34	29	0	29	45	19	0	37	46	20	0	411
07:45 AM	2	144	8	0	1	7	37	0	25	27	8	0	20	36	4	0	319
Total	50	470	20	0	5	102	109	0	93	109	55	0	79	136	39	0	1267
08:00 AM	5	123	6	0	1	16	42	0	32	22	9	0	29	33	4	0	322
08:15 AM	3	114	6	0	1	12	36	0	32	21	4	0	17	35	1	0	282
08:30 AM	4	102	7	0	3	7	28	0	28	23	6	0	15	33	3	0	259
08:45 AM	5	88	6	0	0	14	24	0	30	29	5	0	16	29	5	0	251
Total	17	427	25	0	5	49	130	0	122	95	24	0	77	130	13	0	1114
Grand Total	87	1148	58	0	12	176	309	0	255	242	92	0	168	295	56	0	2898
Apprch %	6.7	88.8	4.5	0	2.4	35.4	62.2	0	43.3	41.1	15.6	0	32.4	56.8	10.8	0	
Total %	3	39.6	2	0	0.4	6.1	10.7	0	8.8	8.4	3.2	0	5.8	10.2	1.9	0	
Cars	78	1140	52	0	7	161	298	0	244	230	83	0	154	272	46	0	2765
% Cars	89.7	99.3	89.7	0	58.3	91.5	96.4	0	95.7	95	90.2	0	91.7	92.2	82.1	0	95.4
Heavy Vehicles	9	8	6	0	5	15	11	0	11	12	9	0	14	23	10	0	133
% Heavy Vehicles	10.3	0.7	10.3	0	41.7	8.5	3.6	0	4.3	5	9.8	0	8.3	7.8	17.9	0	4.6

	South Road From North					Loomis Street From East					South Road From South					Railroad Avenue From West					Int. Total
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15 AM																					
07:15 AM	14	103	2	0	119	0	37	19	0	56	20	28	18	0	66	14	36	8	0	58	299
07:30 AM	24	117	8	0	149	3	34	29	0	66	29	45	19	0	93	37	46	20	0	103	411
07:45 AM	2	144	8	0	154	1	7	37	0	45	25	27	8	0	60	20	36	4	0	60	319
08:00 AM	5	123	6	0	134	1	16	42	0	59	32	22	9	0	63	29	33	4	0	66	322
Total Volume	45	487	24	0	556	5	94	127	0	226	106	122	54	0	282	100	151	36	0	287	1351
% App. Total	8.1	87.6	4.3	0		2.2	41.6	56.2	0		37.6	43.3	19.1	0		34.8	52.6	12.5	0		
PHF	.469	.845	.750	.000	.903	.417	.635	.756	.000	.856	.828	.678	.711	.000	.758	.676	.821	.450	.000	.697	.822
Cars	39	485	22	0	546	3	86	127	0	216	100	117	47	0	264	95	140	35	0	270	1296
% Cars	86.7	99.6	91.7	0	98.2	60.0	91.5	100	0	95.6	94.3	95.9	87.0	0	93.6	95.0	92.7	97.2	0	94.1	95.9
Heavy Vehicles	6	2	2	0	10	2	8	0	0	10	6	5	7	0	18	5	11	1	0	17	55
% Heavy Vehicles	13.3	0.4	8.3	0	1.8	40.0	8.5	0	0	4.4	5.7	4.1	13.0	0	6.4	5.0	7.3	2.8	0	5.9	4.1



PRECISION
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N/S: South Road
E/W: Loomis Street/ Railroad Avenue
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 P
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars

	South Road From North				Loomis Street From East				South Road From South				Railroad Avenue From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
06:00 AM	2	23	3	0	0	3	13	0	7	3	1	0	1	4	0	0	60
06:15 AM	7	58	3	0	0	6	11	0	3	6	2	0	1	3	1	0	101
06:30 AM	2	59	1	0	1	3	20	0	15	11	3	0	2	4	0	0	121
06:45 AM	9	110	4	0	0	13	21	0	15	16	6	0	3	12	0	0	209
Total	20	250	11	0	1	25	65	0	40	36	12	0	7	23	1	0	491
07:00 AM	9	106	2	0	0	22	24	0	16	8	10	0	6	13	1	0	217
07:15 AM	12	103	1	0	0	35	19	0	18	26	17	0	13	34	8	0	286
07:30 AM	20	117	8	0	2	30	29	0	29	43	18	0	37	42	20	0	395
07:45 AM	2	142	8	0	1	7	37	0	24	26	7	0	20	33	4	0	311
Total	43	468	19	0	3	94	109	0	87	103	52	0	76	122	33	0	1209
08:00 AM	5	123	5	0	0	14	42	0	29	22	5	0	25	31	3	0	304
08:15 AM	3	113	5	0	0	8	35	0	31	18	4	0	16	34	1	0	268
08:30 AM	2	99	6	0	3	7	25	0	28	23	5	0	15	33	3	0	249
08:45 AM	5	87	6	0	0	13	22	0	29	28	5	0	15	29	5	0	244
Total	15	422	22	0	3	42	124	0	117	91	19	0	71	127	12	0	1065
Grand Total	78	1140	52	0	7	161	298	0	244	230	83	0	154	272	46	0	2765
Apprch %	6.1	89.8	4.1	0	1.5	34.5	63.9	0	43.8	41.3	14.9	0	32.6	57.6	9.7	0	
Total %	2.8	41.2	1.9	0	0.3	5.8	10.8	0	8.8	8.3	3	0	5.6	9.8	1.7	0	

	South Road From North					Loomis Street From East					South Road From South					Railroad Avenue From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15 AM																					
07:15 AM	12	103	1	0	116	0	35	19	0	54	18	26	17	0	61	13	34	8	0	55	286
07:30 AM	20	117	8	0	145	2	30	29	0	61	29	43	18	0	90	37	42	20	0	99	395
07:45 AM	2	142	8	0	152	1	7	37	0	45	24	26	7	0	57	20	33	4	0	57	311
08:00 AM	5	123	5	0	133	0	14	42	0	56	29	22	5	0	56	25	31	3	0	59	304
Total Volume	39	485	22	0	546	3	86	127	0	216	100	117	47	0	264	95	140	35	0	270	1296
% App. Total	7.1	88.8	4	0		1.4	39.8	58.8	0		37.9	44.3	17.8	0		35.2	51.9	13	0		
PHF	.488	.854	.688	.000	.898	.375	.614	.756	.000	.885	.862	.680	.653	.000	.733	.642	.833	.438	.000	.682	.820



PRECISION
D A T A
INDUSTRIES, LLC

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N/S: South Road
E/W: Loomis Street/ Railroad Avenue
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 P
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

	South Road From North				Loomis Street From East				South Road From South				Railroad Avenue From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
06:00 AM	0	0	0	0	0	0	1	0	0	0	0	0	1	3	0	0	5
06:15 AM	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2
06:30 AM	0	1	0	0	0	0	2	0	0	1	0	0	1	0	0	0	5
06:45 AM	0	0	1	0	1	0	1	0	0	1	1	0	3	3	3	0	14
Total	0	1	2	0	1	0	5	0	0	2	1	0	5	6	3	0	26
07:00 AM	1	0	0	0	1	2	0	0	3	1	0	0	2	5	6	0	21
07:15 AM	2	0	1	0	0	2	0	0	2	2	1	0	1	2	0	0	13
07:30 AM	4	0	0	0	1	4	0	0	0	2	1	0	0	4	0	0	16
07:45 AM	0	2	0	0	0	0	0	0	1	1	1	0	0	3	0	0	8
Total	7	2	1	0	2	8	0	0	6	6	3	0	3	14	6	0	58
08:00 AM	0	0	1	0	1	2	0	0	3	0	4	0	4	2	1	0	18
08:15 AM	0	1	1	0	1	4	1	0	1	3	0	0	1	1	0	0	14
08:30 AM	2	3	1	0	0	0	3	0	0	0	1	0	0	0	0	0	10
08:45 AM	0	1	0	0	0	1	2	0	1	1	0	0	1	0	0	0	7
Total	2	5	3	0	2	7	6	0	5	4	5	0	6	3	1	0	49
Grand Total	9	8	6	0	5	15	11	0	11	12	9	0	14	23	10	0	133
Apprch %	39.1	34.8	26.1	0	16.1	48.4	35.5	0	34.4	37.5	28.1	0	29.8	48.9	21.3	0	
Total %	6.8	6	4.5	0	3.8	11.3	8.3	0	8.3	9	6.8	0	10.5	17.3	7.5	0	

	South Road From North					Loomis Street From East					South Road From South					Railroad Avenue From West					Int. Total
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 06:45 AM																					
06:45 AM	0	0	1	0	1	1	0	1	0	2	0	1	1	0	2	3	3	3	0	9	14
07:00 AM	1	0	0	0	1	1	2	0	0	3	3	1	0	0	4	2	5	6	0	13	21
07:15 AM	2	0	1	0	3	0	2	0	0	2	2	2	1	0	5	1	2	0	0	3	13
07:30 AM	4	0	0	0	4	1	4	0	0	5	0	2	1	0	3	0	4	0	0	4	16
Total Volume	7	0	2	0	9	3	8	1	0	12	5	6	3	0	14	6	14	9	0	29	64
% App. Total	77.8	0	22.2	0		25	66.7	8.3	0		35.7	42.9	21.4	0		20.7	48.3	31	0		
PHF	.438	.000	.500	.000	.563	.750	.500	.250	.000	.600	.417	.750	.750	.000	.700	.500	.700	.375	.000	.558	.762



PRECISION
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N/S: South Road
E/W: Loomis Street/ Railroad Avenue
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 P
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

	South Road From North				Loomis Street From East				South Road From South				Railroad Avenue From West				Int. Total
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	
06:00 AM	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3
06:15 AM	0	0	0	0	0	0	0	1	0	4	0	3	0	0	0	2	10
06:30 AM	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	1	0	4	0	9	0	0	0	2	16
07:00 AM	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	3
07:15 AM	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0	0	4
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	2	0	0	0	0	0	0	1	4	0	0	0	0	7
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
08:15 AM	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	3
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Total	0	0	0	1	0	0	0	2	0	0	0	2	0	0	0	0	5
Grand Total	0	0	0	3	0	0	0	3	0	4	1	15	0	0	0	2	28
Apprch %	0	0	0	100	0	0	0	100	0	20	5	75	0	0	0	100	
Total %	0	0	0	10.7	0	0	0	10.7	0	14.3	3.6	53.6	0	0	0	7.1	

	South Road From North					Loomis Street From East					South Road From South					Railroad Avenue From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 06:00 AM																					
06:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0	0	0	3
06:15 AM	0	0	0	0	0	0	0	0	1	1	0	4	0	3	7	0	0	0	2	2	10
06:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0	0	0	3
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	0	0	1	1	0	4	0	9	13	0	0	0	2	2	16
% App. Total	0	0	0	0	0	0	0	0	100		0	30.8	0	69.2		0	0	0	100		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.250	.250	.000	.250	.000	.750	.464	.000	.000	.000	.250	.250	.400



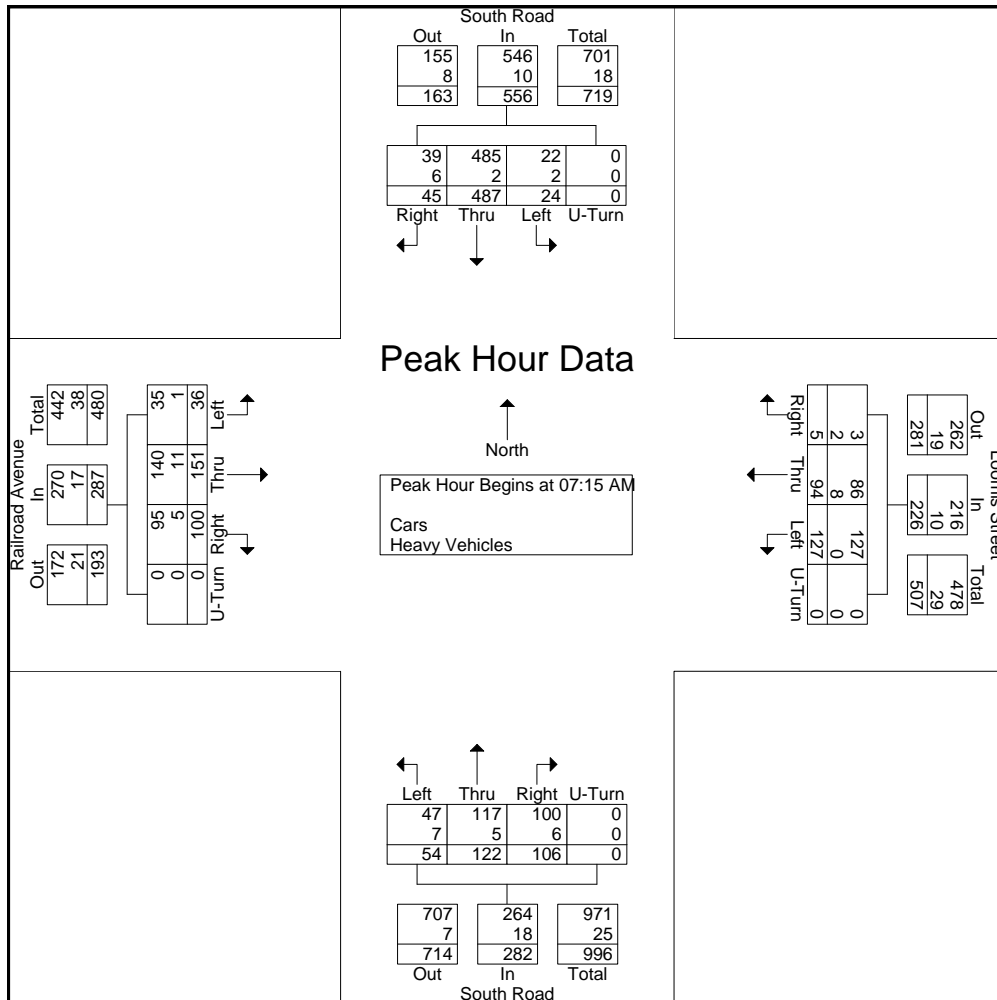
PRECISION
D A T A
INDUSTRIES, LLC

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N/S: South Road
E/W: Loomis Street/ Railroad Avenue
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 P
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

	South Road From North					Loomis Street From East					South Road From South					Railroad Avenue From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15 AM																					
07:15 AM	14	103	2	0	119	0	37	19	0	56	20	28	18	0	66	14	36	8	0	58	299
07:30 AM	24	117	8	0	149	3	34	29	0	66	29	45	19	0	93	37	46	20	0	103	411
07:45 AM	2	144	8	0	154	1	7	37	0	45	25	27	8	0	60	20	36	4	0	60	319
08:00 AM	5	123	6	0	134	1	16	42	0	59	32	22	9	0	63	29	33	4	0	66	322
Total Volume	45	487	24	0	556	5	94	127	0	226	106	122	54	0	282	100	151	36	0	287	1351
% App. Total	8.1	87.6	4.3	0		2.2	41.6	56.2	0		37.6	43.3	19.1	0		34.8	52.6	12.5	0		
PHF	.469	.845	.750	.000	.903	.417	.635	.756	.000	.856	.828	.678	.711	.000	.758	.676	.821	.450	.000	.697	.822
Cars	39	485	22	0	546	3	86	127	0	216	100	117	47	0	264	95	140	35	0	270	1296
% Cars	86.7	99.6	91.7	0	98.2	60.0	91.5	100	0	95.6	94.3	95.9	87.0	0	93.6	95.0	92.7	97.2	0	94.1	95.9
Heavy Vehicles	6	2	2	0	10	2	8	0	0	10	6	5	7	0	18	5	11	1	0	17	55
% Heavy Vehicles	13.3	0.4	8.3	0	1.8	40.0	8.5	0	0	4.4	5.7	4.1	13.0	0	6.4	5.0	7.3	2.8	0	5.9	4.1





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N/S: Massachusetts Avenue/ Cranberry Hill
E/W: Marrett Road (Route 2A)
City, State: Lexington, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 BB
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Massachusetts Avenue From North				Marrett Road (Route 2A) From East				Cranberry Hill From South				Marrett Road (Route 2A) From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
03:00 PM	31	2	76	0	33	96	16	0	37	3	4	0	4	142	19	0	463
03:15 PM	36	10	56	0	47	116	23	0	26	9	0	0	0	121	26	0	470
03:30 PM	40	2	67	0	69	146	15	0	49	13	4	0	1	103	27	0	536
03:45 PM	34	8	65	0	46	152	11	0	25	6	2	0	2	107	36	0	494
Total	141	22	264	0	195	510	65	0	137	31	10	0	7	473	108	0	1963
04:00 PM	32	3	76	0	66	178	10	0	20	9	3	0	0	103	34	0	534
04:15 PM	41	4	64	0	58	148	8	0	19	7	4	0	0	105	31	0	489
04:30 PM	48	6	106	0	43	159	12	0	22	7	5	0	2	111	27	0	548
04:45 PM	45	5	104	0	50	125	11	0	14	9	7	0	1	112	42	0	525
Total	166	18	350	0	217	610	41	0	75	32	19	0	3	431	134	0	2096
05:00 PM	43	10	93	0	52	163	8	0	31	19	4	0	2	109	22	0	556
05:15 PM	36	8	78	0	63	157	10	0	39	28	2	0	3	113	36	0	573
05:30 PM	44	15	103	0	51	151	12	0	19	19	7	0	3	114	30	0	568
05:45 PM	37	10	98	0	52	168	13	0	26	8	4	0	4	105	37	0	562
Total	160	43	372	0	218	639	43	0	115	74	17	0	12	441	125	0	2259
Grand Total	467	83	986	0	630	1759	149	0	327	137	46	0	22	1345	367	0	6318
Apprch %	30.4	5.4	64.2	0	24.8	69.3	5.9	0	64.1	26.9	9	0	1.3	77.6	21.2	0	
Total %	7.4	1.3	15.6	0	10	27.8	2.4	0	5.2	2.2	0.7	0	0.3	21.3	5.8	0	
Cars	465	78	974	0	612	1728	143	0	321	132	46	0	21	1309	358	0	6187
% Cars	99.6	94	98.8	0	97.1	98.2	96	0	98.2	96.4	100	0	95.5	97.3	97.5	0	97.9
Heavy Vehicles	2	5	12	0	18	31	6	0	6	5	0	0	1	36	9	0	131
% Heavy Vehicles	0.4	6	1.2	0	2.9	1.8	4	0	1.8	3.6	0	0	4.5	2.7	2.5	0	2.1

	Massachusetts Avenue From North					Marrett Road (Route 2A) From East					Cranberry Hill From South					Marrett Road (Route 2A) From West					Int. Total
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
05:00 PM	43	10	93	0	146	52	163	8	0	223	31	19	4	0	54	2	109	22	0	133	556
05:15 PM	36	8	78	0	122	63	157	10	0	230	39	28	2	0	69	3	113	36	0	152	573
05:30 PM	44	15	103	0	162	51	151	12	0	214	19	19	7	0	45	3	114	30	0	147	568
05:45 PM	37	10	98	0	145	52	168	13	0	233	26	8	4	0	38	4	105	37	0	146	562
Total Volume	160	43	372	0	575	218	639	43	0	900	115	74	17	0	206	12	441	125	0	578	2259
% App. Total	27.8	7.5	64.7	0		24.2	71	4.8	0		55.8	35.9	8.3	0		2.1	76.3	21.6	0		
PHF	.909	.717	.903	.000	.887	.865	.951	.827	.000	.966	.737	.661	.607	.000	.746	.750	.967	.845	.000	.951	.986
Cars	160	39	369	0	568	215	631	41	0	887	112	72	17	0	201	11	432	124	0	567	2223
% Cars	100	90.7	99.2	0	98.8	98.6	98.7	95.3	0	98.6	97.4	97.3	100	0	97.6	91.7	98.0	99.2	0	98.1	98.4
Heavy Vehicles	0	4	3	0	7	3	8	2	0	13	3	2	0	0	5	1	9	1	0	11	36
% Heavy Vehicles	0	9.3	0.8	0	1.2	1.4	1.3	4.7	0	1.4	2.6	2.7	0	0	2.4	8.3	2.0	0.8	0	1.9	1.6

Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1
Peak Hour for Entire Intersection Begins at 05:00 PM

N/S: Massachusetts Avenue/ Cranberry Hill
 E/W: Marrett Road (Route 2A)
 City, State: Lexington, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 BB
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

Groups Printed- Cars

	Massachusetts Avenue From North				Marrett Road (Route 2A) From East				Cranberry Hill From South				Marrett Road (Route 2A) From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
03:00 PM	31	2	73	0	33	96	15	0	37	3	4	0	4	138	18	0	454
03:15 PM	35	9	55	0	46	113	23	0	26	9	0	0	0	113	26	0	455
03:30 PM	39	2	66	0	69	144	13	0	46	12	4	0	1	100	26	0	522
03:45 PM	34	8	65	0	43	148	11	0	25	6	2	0	2	104	35	0	483
Total	139	21	259	0	191	501	62	0	134	30	10	0	7	455	105	0	1914
04:00 PM	32	3	73	0	64	172	9	0	20	8	3	0	0	102	32	0	518
04:15 PM	41	4	64	0	57	145	8	0	19	7	4	0	0	101	29	0	479
04:30 PM	48	6	105	0	40	157	12	0	22	6	5	0	2	108	26	0	537
04:45 PM	45	5	104	0	45	122	11	0	14	9	7	0	1	111	42	0	516
Total	166	18	346	0	206	596	40	0	75	30	19	0	3	422	129	0	2050
05:00 PM	43	10	91	0	52	163	8	0	31	19	4	0	2	107	21	0	551
05:15 PM	36	6	78	0	61	154	10	0	38	28	2	0	2	110	36	0	561
05:30 PM	44	13	102	0	51	148	10	0	19	18	7	0	3	112	30	0	557
05:45 PM	37	10	98	0	51	166	13	0	24	7	4	0	4	103	37	0	554
Total	160	39	369	0	215	631	41	0	112	72	17	0	11	432	124	0	2223
Grand Total	465	78	974	0	612	1728	143	0	321	132	46	0	21	1309	358	0	6187
Apprch %	30.7	5.1	64.2	0	24.6	69.6	5.8	0	64.3	26.5	9.2	0	1.2	77.5	21.2	0	
Total %	7.5	1.3	15.7	0	9.9	27.9	2.3	0	5.2	2.1	0.7	0	0.3	21.2	5.8	0	

	Massachusetts Avenue From North					Marrett Road (Route 2A) From East					Cranberry Hill From South					Marrett Road (Route 2A) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 05:00 PM																					
05:00 PM	43	10	91	0	144	52	163	8	0	223	31	19	4	0	54	2	107	21	0	130	551
05:15 PM	36	6	78	0	120	61	154	10	0	225	38	28	2	0	68	2	110	36	0	148	561
05:30 PM	44	13	102	0	159	51	148	10	0	209	19	18	7	0	44	3	112	30	0	145	557
05:45 PM	37	10	98	0	145	51	166	13	0	230	24	7	4	0	35	4	103	37	0	144	554
Total Volume	160	39	369	0	568	215	631	41	0	887	112	72	17	0	201	11	432	124	0	567	2223
% App. Total	28.2	6.9	65	0		24.2	71.1	4.6	0		55.7	35.8	8.5	0		1.9	76.2	21.9	0		
PHF	.909	.750	.904	.000	.893	.881	.950	.788	.000	.964	.737	.643	.607	.000	.739	.688	.964	.838	.000	.958	.991

N/S: Massachusetts Avenue/ Cranberry Hill
 E/W: Marrett Road (Route 2A)
 City, State: Lexington, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 BB
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

Groups Printed- Heavy Vehicles

	Massachusetts Avenue From North				Marrett Road (Route 2A) From East				Cranberry Hill From South				Marrett Road (Route 2A) From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
03:00 PM	0	0	3	0	0	0	1	0	0	0	0	0	0	4	1	0	9
03:15 PM	1	1	1	0	1	3	0	0	0	0	0	0	0	8	0	0	15
03:30 PM	1	0	1	0	0	2	2	0	3	1	0	0	0	3	1	0	14
03:45 PM	0	0	0	0	3	4	0	0	0	0	0	0	0	3	1	0	11
Total	2	1	5	0	4	9	3	0	3	1	0	0	0	18	3	0	49
04:00 PM	0	0	3	0	2	6	1	0	0	1	0	0	0	1	2	0	16
04:15 PM	0	0	0	0	1	3	0	0	0	0	0	0	0	4	2	0	10
04:30 PM	0	0	1	0	3	2	0	0	0	1	0	0	0	3	1	0	11
04:45 PM	0	0	0	0	5	3	0	0	0	0	0	0	0	1	0	0	9
Total	0	0	4	0	11	14	1	0	0	2	0	0	0	9	5	0	46
05:00 PM	0	0	2	0	0	0	0	0	0	0	0	0	0	2	1	0	5
05:15 PM	0	2	0	0	2	3	0	0	1	0	0	0	1	3	0	0	12
05:30 PM	0	2	1	0	0	3	2	0	0	1	0	0	0	2	0	0	11
05:45 PM	0	0	0	0	1	2	0	0	2	1	0	0	0	2	0	0	8
Total	0	4	3	0	3	8	2	0	3	2	0	0	1	9	1	0	36
Grand Total	2	5	12	0	18	31	6	0	6	5	0	0	1	36	9	0	131
Apprch %	10.5	26.3	63.2	0	32.7	56.4	10.9	0	54.5	45.5	0	0	2.2	78.3	19.6	0	
Total %	1.5	3.8	9.2	0	13.7	23.7	4.6	0	4.6	3.8	0	0	0.8	27.5	6.9	0	

	Massachusetts Avenue From North					Marrett Road (Route 2A) From East					Cranberry Hill From South					Marrett Road (Route 2A) From West					Int. Total
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 03:15 PM																					
03:15 PM	1	1	1	0	3	1	3	0	0	4	0	0	0	0	0	0	8	0	0	8	15
03:30 PM	1	0	1	0	2	0	2	2	0	4	3	1	0	0	4	0	3	1	0	4	14
03:45 PM	0	0	0	0	0	3	4	0	0	7	0	0	0	0	0	0	3	1	0	4	11
04:00 PM	0	0	3	0	3	2	6	1	0	9	0	1	0	0	1	0	1	2	0	3	16
Total Volume	2	1	5	0	8	6	15	3	0	24	3	2	0	0	5	0	15	4	0	19	56
% App. Total	25	12.5	62.5	0		25	62.5	12.5	0		60	40	0	0		0	78.9	21.1	0		
PHF	.500	.250	.417	.000	.667	.500	.625	.375	.000	.667	.250	.500	.000	.000	.313	.000	.469	.500	.000	.594	.875

N/S: Massachusetts Avenue/ Cranberry Hill
 E/W: Marrett Road (Route 2A)
 City, State: Lexington, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 BB
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

Groups Printed- Peds and Bicycles

	Massachusetts Avenue From North				Marrett Road (Route 2A) From East				Cranberry Hill From South				Marrett Road (Route 2A) From West				Int. Total
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	
03:00 PM	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2
03:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2
Apprch %	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	
Total %	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	

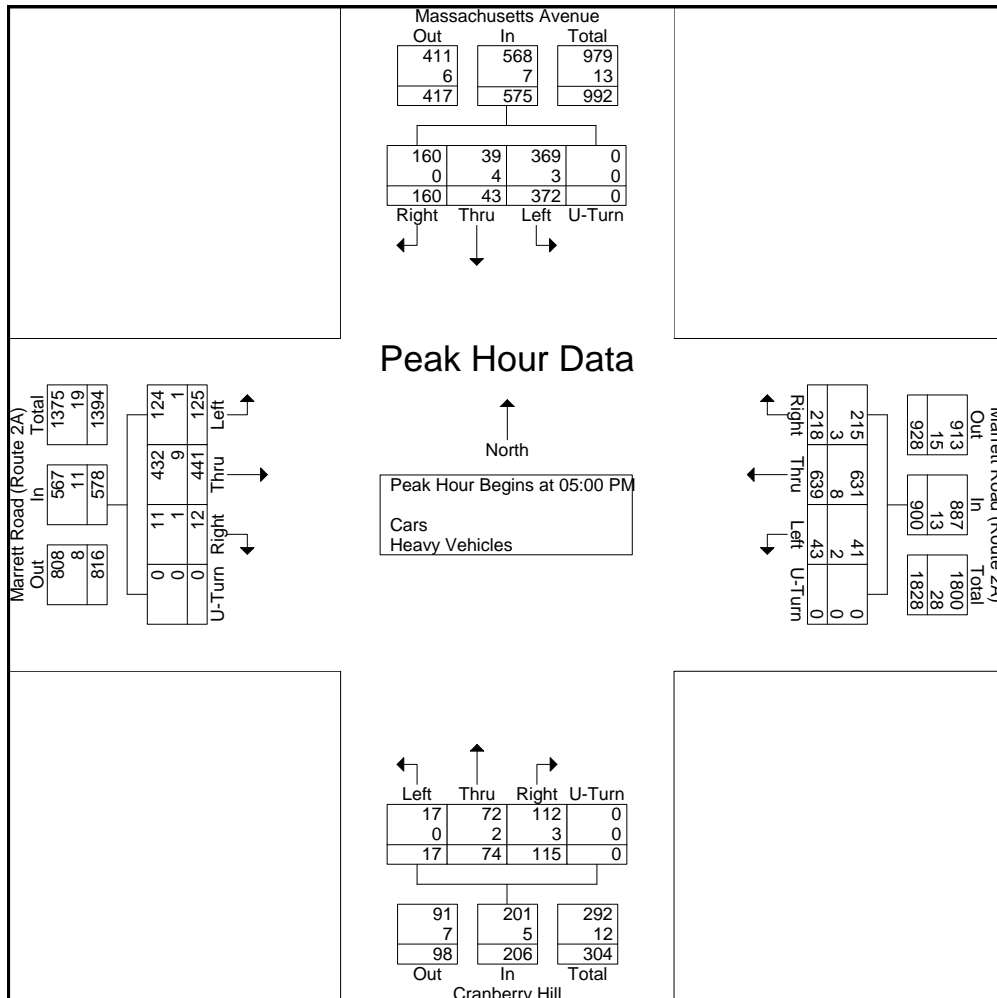
	Massachusetts Avenue From North					Marrett Road (Route 2A) From East					Cranberry Hill From South					Marrett Road (Route 2A) From West					Int. Total
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 03:00 PM																					
03:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	2
03:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	2
% App. Total	0	0	0	0		0	0	0	0		0	0	0	100		0	0	0	0		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.250	.250	.000	.000	.000	.000	.000	.250

N/S: Massachusetts Avenue/ Cranberry Hill
 E/W: Marrett Road (Route 2A)
 City, State: Lexington, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 BB
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

	Massachusetts Avenue From North					Marrett Road (Route 2A) From East					Cranberry Hill From South					Marrett Road (Route 2A) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 05:00 PM																					
05:00 PM	43	10	93	0	146	52	163	8	0	223	31	19	4	0	54	2	109	22	0	133	556
05:15 PM	36	8	78	0	122	63	157	10	0	230	39	28	2	0	69	3	113	36	0	152	573
05:30 PM	44	15	103	0	162	51	151	12	0	214	19	19	7	0	45	3	114	30	0	147	568
05:45 PM	37	10	98	0	145	52	168	13	0	233	26	8	4	0	38	4	105	37	0	146	562
Total Volume	160	43	372	0	575	218	639	43	0	900	115	74	17	0	206	12	441	125	0	578	2259
% App. Total	27.8	7.5	64.7	0		24.2	71	4.8	0		55.8	35.9	8.3	0		2.1	76.3	21.6	0		
PHF	.909	.717	.903	.000	.887	.865	.951	.827	.000	.966	.737	.661	.607	.000	.746	.750	.967	.845	.000	.951	.986
Cars	160	39	369	0	568	215	631	41	0	887	112	72	17	0	201	11	432	124	0	567	2223
% Cars	100	90.7	99.2	0	98.8	98.6	98.7	95.3	0	98.6	97.4	97.3	100	0	97.6	91.7	98.0	99.2	0	98.1	98.4
Heavy Vehicles	0	4	3	0	7	3	8	2	0	13	3	2	0	0	5	1	9	1	0	11	36
% Heavy Vehicles	0	9.3	0.8	0	1.2	1.4	1.3	4.7	0	1.4	2.6	2.7	0	0	2.4	8.3	2.0	0.8	0	1.9	1.6





PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

N: Old Massachusetts Avenue
E/W: Marrett Road (Route 2A)/ Mass Ave
City, State: Lexington, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 CC
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Old Massachusetts Avenue From North			Marrett Road (Route 2A) From East			Massachusetts Avenue (Route 2A) From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
03:00 PM	17	1	0	2	124	0	162	11	0	317
03:15 PM	15	4	0	3	152	1	140	16	0	331
03:30 PM	34	0	0	2	186	0	135	16	0	373
03:45 PM	24	2	0	4	184	0	141	14	0	369
Total	90	7	0	11	646	1	578	57	0	1390
04:00 PM	44	0	0	2	209	0	135	15	0	405
04:15 PM	41	1	0	1	191	0	138	12	0	384
04:30 PM	49	7	0	1	206	0	133	14	0	410
04:45 PM	47	8	0	1	184	0	146	8	0	394
Total	181	16	0	5	790	0	552	49	0	1593
05:00 PM	43	7	0	4	196	0	126	7	0	383
05:15 PM	38	19	0	2	182	0	130	10	0	381
05:30 PM	49	23	0	1	210	0	129	15	0	427
05:45 PM	43	13	0	1	204	0	132	6	0	399
Total	173	62	0	8	792	0	517	38	0	1590
Grand Total	444	85	0	24	2228	1	1647	144	0	4573
Apprch %	83.9	16.1	0	1.1	98.9	0	92	8	0	
Total %	9.7	1.9	0	0.5	48.7	0	36	3.1	0	
Cars	442	79	0	23	2198	1	1608	138	0	4489
% Cars	99.5	92.9	0	95.8	98.7	100	97.6	95.8	0	98.2
Heavy Vehicles	2	6	0	1	30	0	39	6	0	84
% Heavy Vehicles	0.5	7.1	0	4.2	1.3	0	2.4	4.2	0	1.8

	Old Massachusetts Avenue From North				Marrett Road (Route 2A) From East				Massachusetts Avenue (Route 2A) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:00 PM													
04:00 PM	44	0	0	44	2	209	0	211	135	15	0	150	405
04:15 PM	41	1	0	42	1	191	0	192	138	12	0	150	384
04:30 PM	49	7	0	56	1	206	0	207	133	14	0	147	410
04:45 PM	47	8	0	55	1	184	0	185	146	8	0	154	394
Total Volume	181	16	0	197	5	790	0	795	552	49	0	601	1593
% App. Total	91.9	8.1	0		0.6	99.4	0		91.8	8.2	0		
PHF	.923	.500	.000	.879	.625	.945	.000	.942	.945	.817	.000	.976	.971
Cars	181	15	0	196	5	776	0	781	540	47	0	587	1564
% Cars	100	93.8	0	99.5	100	98.2	0	98.2	97.8	95.9	0	97.7	98.2
Heavy Vehicles	0	1	0	1	0	14	0	14	12	2	0	14	29
% Heavy Vehicles	0	6.3	0	0.5	0	1.8	0	1.8	2.2	4.1	0	2.3	1.8



PRECISION
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N: Old Massachusetts Avenue
E/W: Marrett Road (Route 2A)/ Mass Ave
City, State: Lexington, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 CC
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars

	Old Massachusetts Avenue From North			Marrett Road (Route 2A) From East			Massachusetts Avenue (Route 2A) From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
03:00 PM	17	1	0	2	124	0	157	11	0	312
03:15 PM	15	3	0	3	148	1	133	15	0	318
03:30 PM	33	0	0	2	184	0	131	16	0	366
03:45 PM	23	2	0	4	180	0	137	12	0	358
Total	88	6	0	11	636	1	558	54	0	1354
04:00 PM	44	0	0	2	203	0	133	15	0	397
04:15 PM	41	1	0	1	189	0	132	11	0	375
04:30 PM	49	6	0	1	202	0	130	14	0	402
04:45 PM	47	8	0	1	182	0	145	7	0	390
Total	181	15	0	5	776	0	540	47	0	1564
05:00 PM	43	6	0	3	196	0	124	7	0	379
05:15 PM	38	17	0	2	180	0	128	10	0	375
05:30 PM	49	23	0	1	208	0	127	14	0	422
05:45 PM	43	12	0	1	202	0	131	6	0	395
Total	173	58	0	7	786	0	510	37	0	1571
Grand Total	442	79	0	23	2198	1	1608	138	0	4489
Apprch %	84.8	15.2	0	1	98.9	0	92.1	7.9	0	
Total %	9.8	1.8	0	0.5	49	0	35.8	3.1	0	

	Old Massachusetts Avenue From North				Marrett Road (Route 2A) From East				Massachusetts Avenue (Route 2A) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 05:00 PM													
05:00 PM	43	6	0	49	3	196	0	199	124	7	0	131	379
05:15 PM	38	17	0	55	2	180	0	182	128	10	0	138	375
05:30 PM	49	23	0	72	1	208	0	209	127	14	0	141	422
05:45 PM	43	12	0	55	1	202	0	203	131	6	0	137	395
Total Volume	173	58	0	231	7	786	0	793	510	37	0	547	1571
% App. Total	74.9	25.1	0		0.9	99.1	0		93.2	6.8	0		
PHF	.883	.630	.000	.802	.583	.945	.000	.949	.973	.661	.000	.970	.931



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N: Old Massachusetts Avenue
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City, State: Lexington, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 CC
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

	Old Massachusetts Avenue From North			Marrett Road (Route 2A) From East			Massachusetts Avenue (Route 2A) From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
03:00 PM	0	0	0	0	0	0	5	0	0	5
03:15 PM	0	1	0	0	4	0	7	1	0	13
03:30 PM	1	0	0	0	2	0	4	0	0	7
03:45 PM	1	0	0	0	4	0	4	2	0	11
Total	2	1	0	0	10	0	20	3	0	36
04:00 PM	0	0	0	0	6	0	2	0	0	8
04:15 PM	0	0	0	0	2	0	6	1	0	9
04:30 PM	0	1	0	0	4	0	3	0	0	8
04:45 PM	0	0	0	0	2	0	1	1	0	4
Total	0	1	0	0	14	0	12	2	0	29
05:00 PM	0	1	0	1	0	0	2	0	0	4
05:15 PM	0	2	0	0	2	0	2	0	0	6
05:30 PM	0	0	0	0	2	0	2	1	0	5
05:45 PM	0	1	0	0	2	0	1	0	0	4
Total	0	4	0	1	6	0	7	1	0	19
Grand Total	2	6	0	1	30	0	39	6	0	84
Apprch %	25	75	0	3.2	96.8	0	86.7	13.3	0	
Total %	2.4	7.1	0	1.2	35.7	0	46.4	7.1	0	

	Old Massachusetts Avenue From North				Marrett Road (Route 2A) From East				Massachusetts Avenue (Route 2A) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 03:15 PM													
03:15 PM	0	1	0	1	0	4	0	4	7	1	0	8	13
03:30 PM	1	0	0	1	0	2	0	2	4	0	0	4	7
03:45 PM	1	0	0	1	0	4	0	4	4	2	0	6	11
04:00 PM	0	0	0	0	0	6	0	6	2	0	0	2	8
Total Volume	2	1	0	3	0	16	0	16	17	3	0	20	39
% App. Total	66.7	33.3	0		0	100	0		85	15	0		
PHF	.500	.250	.000	.750	.000	.667	.000	.667	.607	.375	.000	.625	.750

N: Old Massachusetts Avenue
 E/W: Marrett Road (Route 2A)/ Mass Ave
 City, State: Lexington, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 CC
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

Groups Printed- Peds and Bicycles

	Old Massachusetts Avenue From North			Marrett Road (Route 2A) From East			Massachusetts Avenue (Route 2A) From West			
Start Time	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	Int. Total
03:00 PM	0	0	1	0	0	0	0	0	0	1
03:15 PM	0	0	0	0	0	0	0	0	0	0
03:30 PM	0	0	0	0	0	0	0	0	0	0
03:45 PM	0	0	0	0	1	0	0	0	0	1
Total	0	0	1	0	1	0	0	0	0	2
04:00 PM	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0
04:45 PM	1	0	0	0	0	0	0	0	0	1
Total	1	0	0	0	0	0	0	0	0	1
05:00 PM	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0
Grand Total	1	0	1	0	1	0	0	0	0	3
Apprch %	50	0	50	0	100	0	0	0	0	
Total %	33.3	0	33.3	0	33.3	0	0	0	0	

	Old Massachusetts Avenue From North				Marrett Road (Route 2A) From East				Massachusetts Avenue (Route 2A) From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 03:00 PM													
03:00 PM	0	0	1	1	0	0	0	0	0	0	0	0	1
03:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
03:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
03:45 PM	0	0	0	0	0	1	0	1	0	0	0	0	1
Total Volume	0	0	1	1	0	1	0	1	0	0	0	0	2
% App. Total	0	0	100		0	100	0		0	0	0		
PHF	.000	.000	.250	.250	.000	.250	.000	.250	.000	.000	.000	.000	.500



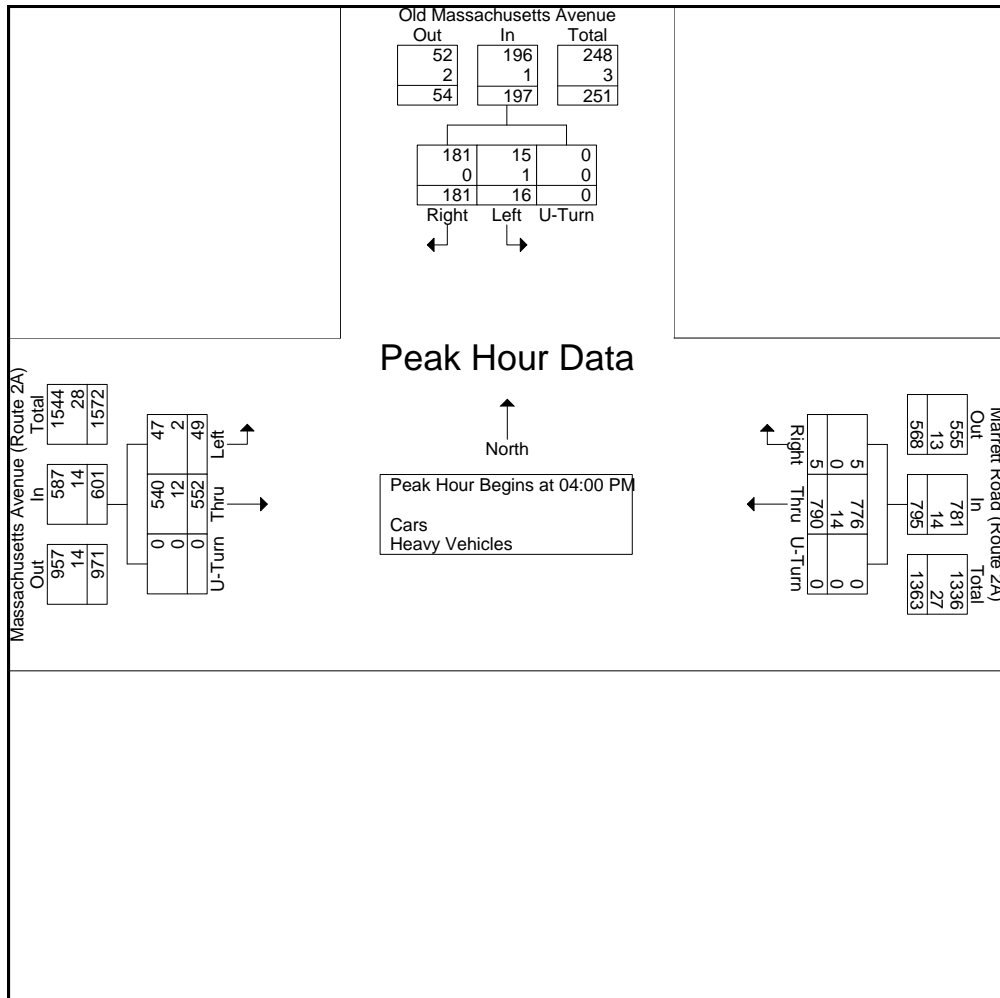
PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
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N: Old Massachusetts Avenue
E/W: Marrett Road (Route 2A)/ Mass Ave
City, State: Lexington, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 CC
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

	Old Massachusetts Avenue From North				Marrett Road (Route 2A) From East				Massachusetts Avenue (Route 2A) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:00 PM													
04:00 PM	44	0	0	44	2	209	0	211	135	15	0	150	405
04:15 PM	41	1	0	42	1	191	0	192	138	12	0	150	384
04:30 PM	49	7	0	56	1	206	0	207	133	14	0	147	410
04:45 PM	47	8	0	55	1	184	0	185	146	8	0	154	394
Total Volume	181	16	0	197	5	790	0	795	552	49	0	601	1593
% App. Total	91.9	8.1	0		0.6	99.4	0		91.8	8.2	0		
PHF	.923	.500	.000	.879	.625	.945	.000	.942	.945	.817	.000	.976	.971
Cars	181	15	0	196	5	776	0	781	540	47	0	587	1564
% Cars	100	93.8	0	99.5	100	98.2	0	98.2	97.8	95.9	0	97.7	98.2
Heavy Vehicles	0	1	0	1	0	14	0	14	12	2	0	14	29
% Heavy Vehicles	0	6.3	0	0.5	0	1.8	0	1.8	2.2	4.1	0	2.3	1.8





PRECISION
D A T A
INDUSTRIES, LLC

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N: Marrett Street (Airport Road)
E/W: Massachusetts Avenue (Route 2A)
City, State: Lexington, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 DD
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Marrett Street (Airport Road) From North			Massachusetts Avenue (Route 2A) From East			Massachusetts Avenue (Route 2A) From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
03:00 PM	0	0	0	0	141	1	172	0	0	314
03:15 PM	0	1	0	1	166	0	158	0	0	326
03:30 PM	0	0	0	1	214	0	149	0	0	364
03:45 PM	0	1	0	0	212	0	156	0	0	369
Total	0	2	0	2	733	1	635	0	0	1373
04:00 PM	1	2	0	0	249	2	139	0	1	394
04:15 PM	0	0	0	2	229	0	151	0	0	382
04:30 PM	0	1	0	0	255	0	149	0	0	405
04:45 PM	0	0	0	0	231	1	150	0	0	382
Total	1	3	0	2	964	3	589	0	1	1563
05:00 PM	0	0	0	0	238	0	136	0	0	374
05:15 PM	0	0	0	0	208	0	140	0	0	348
05:30 PM	0	0	0	0	254	3	145	0	0	402
05:45 PM	0	0	0	1	252	1	136	0	0	390
Total	0	0	0	1	952	4	557	0	0	1514
Grand Total	1	5	0	5	2649	8	1781	0	1	4450
Apprch %	16.7	83.3	0	0.2	99.5	0.3	99.9	0	0.1	
Total %	0	0.1	0	0.1	59.5	0.2	40	0	0	
Cars	1	5	0	5	2619	8	1739	0	1	4378
% Cars	100	100	0	100	98.9	100	97.6	0	100	98.4
Heavy Vehicles	0	0	0	0	30	0	42	0	0	72
% Heavy Vehicles	0	0	0	0	1.1	0	2.4	0	0	1.6

	Marrett Street (Airport Road) From North				Massachusetts Avenue (Route 2A) From East				Massachusetts Avenue (Route 2A) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:00 PM													
04:00 PM	1	2	0	3	0	249	2	251	139	0	1	140	394
04:15 PM	0	0	0	0	2	229	0	231	151	0	0	151	382
04:30 PM	0	1	0	1	0	255	0	255	149	0	0	149	405
04:45 PM	0	0	0	0	0	231	1	232	150	0	0	150	382
Total Volume	1	3	0	4	2	964	3	969	589	0	1	590	1563
% App. Total	25	75	0		0.2	99.5	0.3		99.8	0	0.2		
PHF	.250	.375	.000	.333	.250	.945	.375	.950	.975	.000	.250	.977	.965
Cars	1	3	0	4	2	952	3	957	575	0	1	576	1537
% Cars	100	100	0	100	100	98.8	100	98.8	97.6	0	100	97.6	98.3
Heavy Vehicles	0	0	0	0	0	12	0	12	14	0	0	14	26
% Heavy Vehicles	0	0	0	0	0	1.2	0	1.2	2.4	0	0	2.4	1.7



PRECISION
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N: Marrett Street (Airport Road)
E/W: Massachusetts Avenue (Route 2A)
City, State: Lexington, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 DD
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars

	Marrett Street (Airport Road) From North			Massachusetts Avenue (Route 2A) From East			Massachusetts Avenue (Route 2A) From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
03:00 PM	0	0	0	0	141	1	167	0	0	309
03:15 PM	0	1	0	1	163	0	153	0	0	318
03:30 PM	0	0	0	1	210	0	144	0	0	355
03:45 PM	0	1	0	0	207	0	151	0	0	359
Total	0	2	0	2	721	1	615	0	0	1341
04:00 PM	1	2	0	0	244	2	136	0	1	386
04:15 PM	0	0	0	2	227	0	145	0	0	374
04:30 PM	0	1	0	0	252	0	146	0	0	399
04:45 PM	0	0	0	0	229	1	148	0	0	378
Total	1	3	0	2	952	3	575	0	1	1537
05:00 PM	0	0	0	0	238	0	134	0	0	372
05:15 PM	0	0	0	0	206	0	138	0	0	344
05:30 PM	0	0	0	0	252	3	142	0	0	397
05:45 PM	0	0	0	1	250	1	135	0	0	387
Total	0	0	0	1	946	4	549	0	0	1500
Grand Total	1	5	0	5	2619	8	1739	0	1	4378
Apprch %	16.7	83.3	0	0.2	99.5	0.3	99.9	0	0.1	
Total %	0	0.1	0	0.1	59.8	0.2	39.7	0	0	

	Marrett Street (Airport Road) From North				Massachusetts Avenue (Route 2A) From East				Massachusetts Avenue (Route 2A) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:00 PM													
04:00 PM	1	2	0	3	0	244	2	246	136	0	1	137	386
04:15 PM	0	0	0	0	2	227	0	229	145	0	0	145	374
04:30 PM	0	1	0	1	0	252	0	252	146	0	0	146	399
04:45 PM	0	0	0	0	0	229	1	230	148	0	0	148	378
Total Volume	1	3	0	4	2	952	3	957	575	0	1	576	1537
% App. Total	25	75	0		0.2	99.5	0.3		99.8	0	0.2		
PHF	.250	.375	.000	.333	.250	.944	.375	.949	.971	.000	.250	.973	.963

N: Marrett Street (Airport Road)
 E/W: Massachusetts Avenue (Route 2A)
 City, State: Lexington, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 DD
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

Groups Printed- Heavy Vehicles

	Marrett Street (Airport Road) From North			Massachusetts Avenue (Route 2A) From East			Massachusetts Avenue (Route 2A) From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
03:00 PM	0	0	0	0	0	0	5	0	0	5
03:15 PM	0	0	0	0	3	0	5	0	0	8
03:30 PM	0	0	0	0	4	0	5	0	0	9
03:45 PM	0	0	0	0	5	0	5	0	0	10
Total	0	0	0	0	12	0	20	0	0	32
04:00 PM	0	0	0	0	5	0	3	0	0	8
04:15 PM	0	0	0	0	2	0	6	0	0	8
04:30 PM	0	0	0	0	3	0	3	0	0	6
04:45 PM	0	0	0	0	2	0	2	0	0	4
Total	0	0	0	0	12	0	14	0	0	26
05:00 PM	0	0	0	0	0	0	2	0	0	2
05:15 PM	0	0	0	0	2	0	2	0	0	4
05:30 PM	0	0	0	0	2	0	3	0	0	5
05:45 PM	0	0	0	0	2	0	1	0	0	3
Total	0	0	0	0	6	0	8	0	0	14
Grand Total	0	0	0	0	30	0	42	0	0	72
Apprch %	0	0	0	0	100	0	100	0	0	
Total %	0	0	0	0	41.7	0	58.3	0	0	

	Marrett Street (Airport Road) From North				Massachusetts Avenue (Route 2A) From East				Massachusetts Avenue (Route 2A) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 03:15 PM													
03:15 PM	0	0	0	0	0	3	0	3	5	0	0	5	8
03:30 PM	0	0	0	0	0	4	0	4	5	0	0	5	9
03:45 PM	0	0	0	0	0	5	0	5	5	0	0	5	10
04:00 PM	0	0	0	0	0	5	0	5	3	0	0	3	8
Total Volume	0	0	0	0	0	17	0	17	18	0	0	18	35
% App. Total	0	0	0		0	100	0		100	0	0		
PHF	.000	.000	.000	.000	.000	.850	.000	.850	.900	.000	.000	.900	.875



PRECISION
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N: Marrett Street (Airport Road)
E/W: Massachusetts Avenue (Route 2A)
City, State: Lexington, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 DD
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

	Marrett Street (Airport Road) From North			Massachusetts Avenue (Route 2A) From East			Massachusetts Avenue (Route 2A) From West			
Start Time	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	Int. Total
03:00 PM	0	0	0	0	0	0	0	0	0	0
03:15 PM	0	0	0	0	0	0	0	0	0	0
03:30 PM	0	0	0	0	0	0	0	0	0	0
03:45 PM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0
04:00 PM	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	1	0	0	0	0	1
Total	0	0	0	0	1	0	0	0	0	1
05:00 PM	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	1	0	0	0	0	1
Apprch %	0	0	0	0	100	0	0	0	0	
Total %	0	0	0	0	100	0	0	0	0	

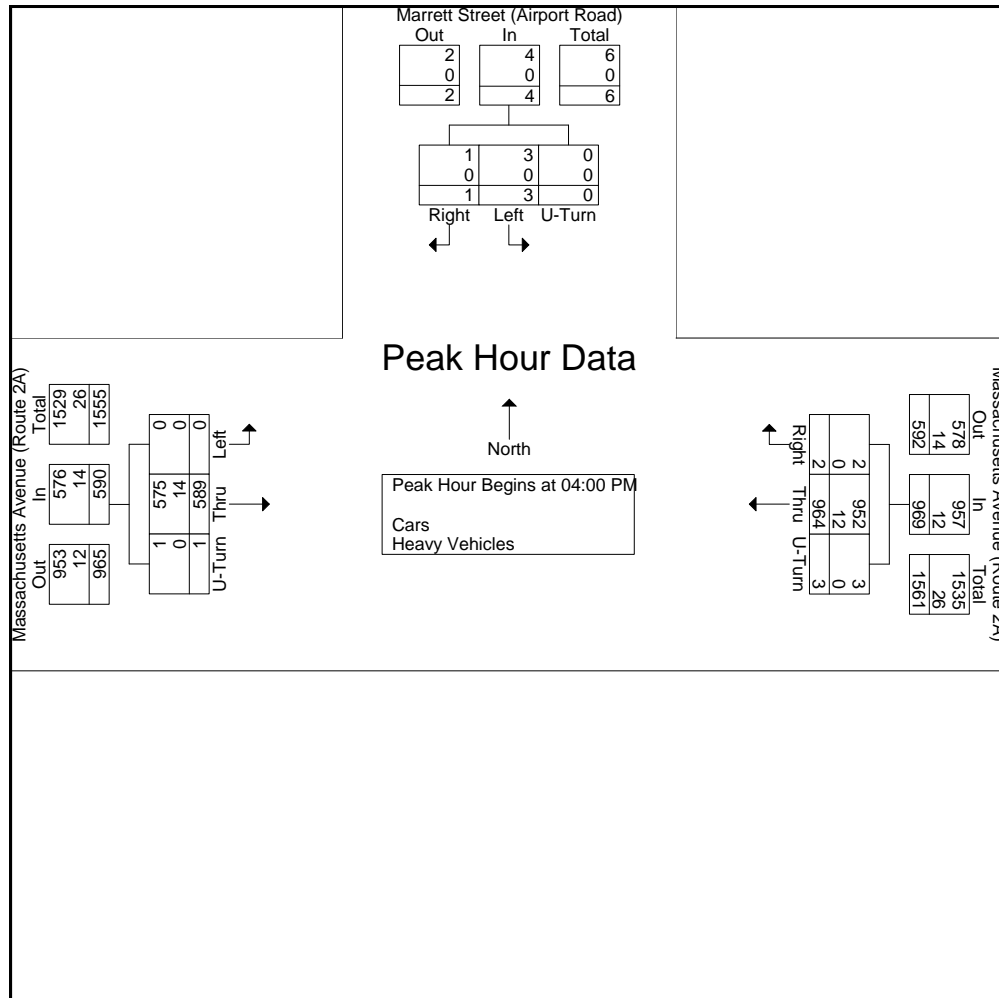
	Marrett Street (Airport Road) From North				Massachusetts Avenue (Route 2A) From East				Massachusetts Avenue (Route 2A) From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:00 PM													
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	1	0	1	0	0	0	0	1
Total Volume	0	0	0	0	0	1	0	1	0	0	0	0	1
% App. Total	0	0	0		0	100	0		0	0	0		
PHF	.000	.000	.000	.000	.000	.250	.000	.250	.000	.000	.000	.000	.250

N: Marrett Street (Airport Road)
 E/W: Massachusetts Avenue (Route 2A)
 City, State: Lexington, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 DD
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

	Marrett Street (Airport Road) From North				Massachusetts Avenue (Route 2A) From East				Massachusetts Avenue (Route 2A) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:00 PM													
04:00 PM	1	2	0	3	0	249	2	251	139	0	1	140	394
04:15 PM	0	0	0	0	2	229	0	231	151	0	0	151	382
04:30 PM	0	1	0	1	0	255	0	255	149	0	0	149	405
04:45 PM	0	0	0	0	0	231	1	232	150	0	0	150	382
Total Volume	1	3	0	4	2	964	3	969	589	0	1	590	1563
% App. Total	25	75	0		0.2	99.5	0.3		99.8	0	0.2		
PHF	.250	.375	.000	.333	.250	.945	.375	.950	.975	.000	.250	.977	.965
Cars	1	3	0	4	2	952	3	957	575	0	1	576	1537
% Cars	100	100	0	100	100	98.8	100	98.8	97.6	0	100	97.6	98.3
Heavy Vehicles	0	0	0	0	0	12	0	12	14	0	0	14	26
% Heavy Vehicles	0	0	0	0	0	1.2	0	1.2	2.4	0	0	2.4	1.7





PRECISION
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N/S: Airport/ Hanscom Drive
E/W: Vandenburg Gate/ Old Bedford Road
City, State: Lincoln, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 EE
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Hanscom Drive (Airport) From North				Old Bedford Road (Vandenburg Gate) From East				Hanscom Drive From South				Old Bedford Road From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
03:00 PM	5	65	3	0	2	28	88	0	12	6	15	1	47	7	5	0	284
03:15 PM	2	15	0	0	2	15	54	0	28	8	22	1	16	3	1	0	167
03:30 PM	1	18	0	0	0	44	93	0	18	8	11	0	31	10	1	0	235
03:45 PM	2	11	0	0	0	14	79	0	22	3	12	0	22	5	0	0	170
Total	10	109	3	0	4	101	314	0	80	25	60	2	116	25	7	0	856
04:00 PM	1	22	2	0	0	36	112	0	17	7	16	0	34	8	0	0	255
04:15 PM	0	16	0	0	0	44	117	0	34	6	20	0	29	6	1	0	273
04:30 PM	0	15	1	0	0	72	131	0	22	4	30	0	30	6	2	0	313
04:45 PM	0	7	2	0	0	51	109	0	25	6	29	0	18	6	2	0	255
Total	1	60	5	0	0	203	469	0	98	23	95	0	111	26	5	0	1096
05:00 PM	0	16	0	0	0	53	99	0	26	7	21	0	47	3	0	0	272
05:15 PM	0	9	0	0	0	59	86	0	24	6	25	1	32	1	0	0	243
05:30 PM	0	13	0	0	0	23	85	0	13	4	20	0	39	7	0	0	204
05:45 PM	0	11	0	0	0	20	69	0	11	2	19	0	32	6	0	0	170
Total	0	49	0	0	0	155	339	0	74	19	85	1	150	17	0	0	889
Grand Total	11	218	8	0	4	459	1122	0	252	67	240	3	377	68	12	0	2841
Apprch %	4.6	92	3.4	0	0.3	29	70.8	0	44.8	11.9	42.7	0.5	82.5	14.9	2.6	0	
Total %	0.4	7.7	0.3	0	0.1	16.2	39.5	0	8.9	2.4	8.4	0.1	13.3	2.4	0.4	0	
Cars	11	209	8	0	3	458	1110	0	248	61	236	3	374	68	12	0	2801
% Cars	100	95.9	100	0	75	99.8	98.9	0	98.4	91	98.3	100	99.2	100	100	0	98.6
Heavy Vehicles	0	9	0	0	1	1	12	0	4	6	4	0	3	0	0	0	40
% Heavy Vehicles	0	4.1	0	0	25	0.2	1.1	0	1.6	9	1.7	0	0.8	0	0	0	1.4

	Hanscom Drive (Airport) From North					Old Bedford Road (Vandenburg Gate) From East					Hanscom Drive From South					Old Bedford Road From West					Int. Total
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	0	16	0	0	16	0	44	117	0	161	34	6	20	0	60	29	6	1	0	36	273
04:30 PM	0	15	1	0	16	0	72	131	0	203	22	4	30	0	56	30	6	2	0	38	313
04:45 PM	0	7	2	0	9	0	51	109	0	160	25	6	29	0	60	18	6	2	0	26	255
05:00 PM	0	16	0	0	16	0	53	99	0	152	26	7	21	0	54	47	3	0	0	50	272
Total Volume	0	54	3	0	57	0	220	456	0	676	107	23	100	0	230	124	21	5	0	150	1113
% App. Total	0	94.7	5.3	0		0	32.5	67.5	0		46.5	10	43.5	0		82.7	14	3.3	0		
PHF	.000	.844	.375	.000	.891	.000	.764	.870	.000	.833	.787	.821	.833	.000	.958	.660	.875	.625	.000	.750	.889
Cars	0	52	3	0	55	0	220	450	0	670	106	21	99	0	226	124	21	5	0	150	1101
% Cars	0	96.3	100	0	96.5	0	100	98.7	0	99.1	99.1	91.3	99.0	0	98.3	100	100	100	0	100	98.9
Heavy Vehicles	0	2	0	0	2	0	0	6	0	6	1	2	1	0	4	0	0	0	0	0	12
% Heavy Vehicles	0	3.7	0	0	3.5	0	0	1.3	0	0.9	0.9	8.7	1.0	0	1.7	0	0	0	0	0	1.1



PRECISION
D A T A
INDUSTRIES, LLC

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Email: datarequests@pdillc.com

N/S: Airport/ Hanscom Drive
E/W: Vandenberg Gate/ Old Bedford Road
City, State: Lincoln, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 EE
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars

	Hanscom Drive (Airport) From North				Old Bedford Road (Vandenberg Gate) From East				Hanscom Drive From South				Old Bedford Road From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
03:00 PM	5	63	3	0	2	28	87	0	11	5	14	1	45	7	5	0	276
03:15 PM	2	15	0	0	1	14	54	0	27	7	21	1	15	3	1	0	161
03:30 PM	1	17	0	0	0	44	92	0	18	8	11	0	31	10	1	0	233
03:45 PM	2	10	0	0	0	14	77	0	22	3	12	0	22	5	0	0	167
Total	10	105	3	0	3	100	310	0	78	23	58	2	113	25	7	0	837
04:00 PM	1	22	2	0	0	36	112	0	16	6	16	0	34	8	0	0	253
04:15 PM	0	15	0	0	0	44	115	0	34	6	20	0	29	6	1	0	270
04:30 PM	0	15	1	0	0	72	129	0	21	4	30	0	30	6	2	0	310
04:45 PM	0	6	2	0	0	51	109	0	25	4	28	0	18	6	2	0	251
Total	1	58	5	0	0	203	465	0	96	20	94	0	111	26	5	0	1084
05:00 PM	0	16	0	0	0	53	97	0	26	7	21	0	47	3	0	0	270
05:15 PM	0	9	0	0	0	59	85	0	24	6	24	1	32	1	0	0	241
05:30 PM	0	11	0	0	0	23	85	0	13	3	20	0	39	7	0	0	201
05:45 PM	0	10	0	0	0	20	68	0	11	2	19	0	32	6	0	0	168
Total	0	46	0	0	0	155	335	0	74	18	84	1	150	17	0	0	880
Grand Total	11	209	8	0	3	458	1110	0	248	61	236	3	374	68	12	0	2801
Apprch %	4.8	91.7	3.5	0	0.2	29.2	70.7	0	45.3	11.1	43.1	0.5	82.4	15	2.6	0	
Total %	0.4	7.5	0.3	0	0.1	16.4	39.6	0	8.9	2.2	8.4	0.1	13.4	2.4	0.4	0	

	Hanscom Drive (Airport) From North					Old Bedford Road (Vandenberg Gate) From East					Hanscom Drive From South					Old Bedford Road From West					Int. Total
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	0	15	0	0	15	0	44	115	0	159	34	6	20	0	60	29	6	1	0	36	270
04:30 PM	0	15	1	0	16	0	72	129	0	201	21	4	30	0	55	30	6	2	0	38	310
04:45 PM	0	6	2	0	8	0	51	109	0	160	25	4	28	0	57	18	6	2	0	26	251
05:00 PM	0	16	0	0	16	0	53	97	0	150	26	7	21	0	54	47	3	0	0	50	270
Total Volume	0	52	3	0	55	0	220	450	0	670	106	21	99	0	226	124	21	5	0	150	1101
% App. Total	0	94.5	5.5	0		0	32.8	67.2	0		46.9	9.3	43.8	0		82.7	14	3.3	0		
PHF	.000	.813	.375	.000	.859	.000	.764	.872	.000	.833	.779	.750	.825	.000	.942	.660	.875	.625	.000	.750	.888



PRECISION
D A T A
INDUSTRIES, LLC

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N/S: Airport/ Hanscom Drive
E/W: Vandenburg Gate/ Old Bedford Road
City, State: Lincoln, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 EE
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

	Hanscom Drive (Airport) From North				Old Bedford Road (Vandenburg Gate) From East				Hanscom Drive From South				Old Bedford Road From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
03:00 PM	0	2	0	0	0	0	1	0	1	1	1	0	2	0	0	0	8
03:15 PM	0	0	0	0	1	1	0	0	1	1	1	0	1	0	0	0	6
03:30 PM	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2
03:45 PM	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	3
Total	0	4	0	0	1	1	4	0	2	2	2	0	3	0	0	0	19
04:00 PM	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	2
04:15 PM	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	3
04:30 PM	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	3
04:45 PM	0	1	0	0	0	0	0	0	0	2	1	0	0	0	0	0	4
Total	0	2	0	0	0	0	4	0	2	3	1	0	0	0	0	0	12
05:00 PM	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2
05:15 PM	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	2
05:30 PM	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3
05:45 PM	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2
Total	0	3	0	0	0	0	4	0	0	1	1	0	0	0	0	0	9
Grand Total	0	9	0	0	1	1	12	0	4	6	4	0	3	0	0	0	40
Apprch %	0	100	0	0	7.1	7.1	85.7	0	28.6	42.9	28.6	0	100	0	0	0	
Total %	0	22.5	0	0	2.5	2.5	30	0	10	15	10	0	7.5	0	0	0	

	Hanscom Drive (Airport) From North					Old Bedford Road (Vandenburg Gate) From East					Hanscom Drive From South					Old Bedford Road From West					Int. Total
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 03:00 PM																					
03:00 PM	0	2	0	0	2	0	0	1	0	1	1	1	1	0	3	2	0	0	0	2	8
03:15 PM	0	0	0	0	0	1	1	0	0	2	1	1	1	0	3	1	0	0	0	1	6
03:30 PM	0	1	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	2
03:45 PM	0	1	0	0	1	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	3
Total Volume	0	4	0	0	4	1	1	4	0	6	2	2	2	0	6	3	0	0	0	3	19
% App. Total	0	100	0	0		16.7	16.7	66.7	0		33.3	33.3	33.3	0		100	0	0	0		
PHF	.000	.500	.000	.000	.500	.250	.250	.500	.000	.750	.500	.500	.500	.000	.500	.375	.000	.000	.000	.375	.594



PRECISION
DATA
INDUSTRIES, LLC

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File Name : 123082 EE
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

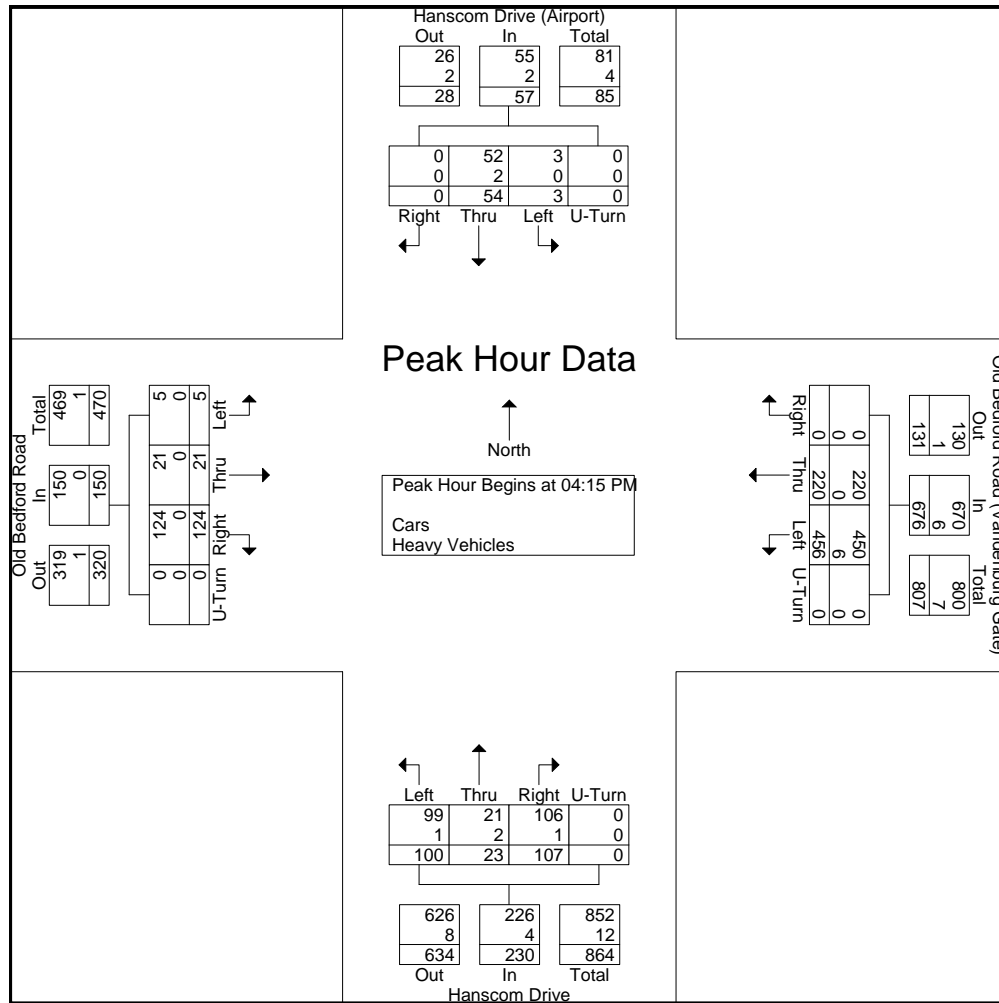
[illegible][illegible]

N/S: Airport/ Hanscom Drive
 E/W: Vandenburg Gate/ Old Bedford Road
 City, State: Lincoln, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 EE
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

	Hanscom Drive (Airport) From North					Old Bedford Road (Vandenburg Gate) From East					Hanscom Drive From South					Old Bedford Road From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	0	16	0	0	16	0	44	117	0	161	34	6	20	0	60	29	6	1	0	36	273
04:30 PM	0	15	1	0	16	0	72	131	0	203	22	4	30	0	56	30	6	2	0	38	313
04:45 PM	0	7	2	0	9	0	51	109	0	160	25	6	29	0	60	18	6	2	0	26	255
05:00 PM	0	16	0	0	16	0	53	99	0	152	26	7	21	0	54	47	3	0	0	50	272
Total Volume	0	54	3	0	57	0	220	456	0	676	107	23	100	0	230	124	21	5	0	150	1113
% App. Total	0	94.7	5.3	0		0	32.5	67.5	0		46.5	10	43.5	0		82.7	14	3.3	0		
PHF	.000	.844	.375	.000	.891	.000	.764	.870	.000	.833	.787	.821	.833	.000	.958	.660	.875	.625	.000	.750	.889
Cars	0	52	3	0	55	0	220	450	0	670	106	21	99	0	226	124	21	5	0	150	1101
% Cars	0	96.3	100	0	96.5	0	100	98.7	0	99.1	99.1	91.3	99.0	0	98.3	100	100	100	0	100	98.9
Heavy Vehicles	0	2	0	0	2	0	0	6	0	6	1	2	1	0	4	0	0	0	0	0	12
% Heavy Vehicles	0	3.7	0	0	3.5	0	0	1.3	0	0.9	0.9	8.7	1.0	0	1.7	0	0	0	0	0	1.1





PRECISION
D A T A
INDUSTRIES, LLC

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N: Hanscom Drive
E/W: North Great Road (Route 2A)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 FF
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

Start Time	Hanscom Drive From North			North Great Road (Route 2A) From East			North Great Road (Route 2A) From West			Int. Total
	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	
03:00 PM	138	92	0	33	114	0	76	11	0	464
03:15 PM	52	65	0	33	126	0	107	28	0	411
03:30 PM	69	54	0	27	193	0	99	11	0	453
03:45 PM	62	61	0	26	197	0	79	20	0	445
Total	321	272	0	119	630	0	361	70	0	1773
04:00 PM	84	69	0	25	203	0	79	23	0	483
04:15 PM	96	64	0	39	201	0	83	25	0	508
04:30 PM	104	73	0	33	187	0	77	20	0	494
04:45 PM	81	52	0	53	208	0	85	24	0	503
Total	365	258	0	150	799	0	324	92	0	1988
05:00 PM	89	54	0	33	214	0	80	18	0	488
05:15 PM	85	66	0	47	189	0	70	17	0	474
05:30 PM	78	62	0	32	209	0	90	14	0	485
05:45 PM	49	47	0	30	229	0	86	21	0	462
Total	301	229	0	142	841	0	326	70	0	1909
Grand Total	987	759	0	411	2270	0	1011	232	0	5670
Apprch %	56.5	43.5	0	15.3	84.7	0	81.3	18.7	0	
Total %	17.4	13.4	0	7.2	40	0	17.8	4.1	0	
Cars	975	742	0	400	2244	0	984	227	0	5572
% Cars	98.8	97.8	0	97.3	98.9	0	97.3	97.8	0	98.3
Heavy Vehicles	12	17	0	11	26	0	27	5	0	98
% Heavy Vehicles	1.2	2.2	0	2.7	1.1	0	2.7	2.2	0	1.7

	Hanscom Drive From North				North Great Road (Route 2A) From East				North Great Road (Route 2A) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:15 PM													
04:15 PM	96	64	0	160	39	201	0	240	83	25	0	108	508
04:30 PM	104	73	0	177	33	187	0	220	77	20	0	97	494
04:45 PM	81	52	0	133	53	208	0	261	85	24	0	109	503
05:00 PM	89	54	0	143	33	214	0	247	80	18	0	98	488
Total Volume	370	243	0	613	158	810	0	968	325	87	0	412	1993
% App. Total	60.4	39.6	0		16.3	83.7	0		78.9	21.1	0		
PHF	.889	.832	.000	.866	.745	.946	.000	.927	.956	.870	.000	.945	.981
Cars	367	240	0	607	156	803	0	959	314	86	0	400	1966
% Cars	99.2	98.8	0	99.0	98.7	99.1	0	99.1	96.6	98.9	0	97.1	98.6
Heavy Vehicles	3	3	0	6	2	7	0	9	11	1	0	12	27
% Heavy Vehicles	0.8	1.2	0	1.0	1.3	0.9	0	0.9	3.4	1.1	0	2.9	1.4

N: Hanscom Drive
 E/W: North Great Road (Route 2A)
 City, State: Bedford, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 FF
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

Groups Printed- Cars										
	Hanscom Drive From North			North Great Road (Route 2A) From East			North Great Road (Route 2A) From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
03:00 PM	134	88	0	32	114	0	75	9	0	452
03:15 PM	49	64	0	32	124	0	102	26	0	397
03:30 PM	69	52	0	27	186	0	96	11	0	441
03:45 PM	62	59	0	26	194	0	76	20	0	437
Total	314	263	0	117	618	0	349	66	0	1727
04:00 PM	83	69	0	22	198	0	77	23	0	472
04:15 PM	94	63	0	39	199	0	77	25	0	497
04:30 PM	104	72	0	33	185	0	75	19	0	488
04:45 PM	80	51	0	51	205	0	84	24	0	495
Total	361	255	0	145	787	0	313	91	0	1952
05:00 PM	89	54	0	33	214	0	78	18	0	486
05:15 PM	85	64	0	47	188	0	70	17	0	471
05:30 PM	78	60	0	30	208	0	88	14	0	478
05:45 PM	48	46	0	28	229	0	86	21	0	458
Total	300	224	0	138	839	0	322	70	0	1893
Grand Total	975	742	0	400	2244	0	984	227	0	5572
Apprch %	56.8	43.2	0	15.1	84.9	0	81.3	18.7	0	
Total %	17.5	13.3	0	7.2	40.3	0	17.7	4.1	0	

	Hanscom Drive From North				North Great Road (Route 2A) From East				North Great Road (Route 2A) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:15 PM													
04:15 PM	94	63	0	157	39	199	0	238	77	25	0	102	497
04:30 PM	104	72	0	176	33	185	0	218	75	19	0	94	488
04:45 PM	80	51	0	131	51	205	0	256	84	24	0	108	495
05:00 PM	89	54	0	143	33	214	0	247	78	18	0	96	486
Total Volume	367	240	0	607	156	803	0	959	314	86	0	400	1966
% App. Total	60.5	39.5	0		16.3	83.7	0		78.5	21.5	0		
PHF	.882	.833	.000	.862	.765	.938	.000	.937	.935	.860	.000	.926	.989



PRECISION
D A T A
INDUSTRIES, LLC

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N: Hanscom Drive
E/W: North Great Road (Route 2A)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 FF
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

Start Time	Hanscom Drive From North			North Great Road (Route 2A) From East			North Great Road (Route 2A) From West			Int. Total
	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	
03:00 PM	4	4	0	1	0	0	1	2	0	12
03:15 PM	3	1	0	1	2	0	5	2	0	14
03:30 PM	0	2	0	0	7	0	3	0	0	12
03:45 PM	0	2	0	0	3	0	3	0	0	8
Total	7	9	0	2	12	0	12	4	0	46
04:00 PM	1	0	0	3	5	0	2	0	0	11
04:15 PM	2	1	0	0	2	0	6	0	0	11
04:30 PM	0	1	0	0	2	0	2	1	0	6
04:45 PM	1	1	0	2	3	0	1	0	0	8
Total	4	3	0	5	12	0	11	1	0	36
05:00 PM	0	0	0	0	0	0	2	0	0	2
05:15 PM	0	2	0	0	1	0	0	0	0	3
05:30 PM	0	2	0	2	1	0	2	0	0	7
05:45 PM	1	1	0	2	0	0	0	0	0	4
Total	1	5	0	4	2	0	4	0	0	16
Grand Total	12	17	0	11	26	0	27	5	0	98
Apprch %	41.4	58.6	0	29.7	70.3	0	84.4	15.6	0	
Total %	12.2	17.3	0	11.2	26.5	0	27.6	5.1	0	

	Hanscom Drive From North				North Great Road (Route 2A) From East				North Great Road (Route 2A) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 03:00 PM													
03:00 PM	4	4	0	8	1	0	0	1	1	2	0	3	12
03:15 PM	3	1	0	4	1	2	0	3	5	2	0	7	14
03:30 PM	0	2	0	2	0	7	0	7	3	0	0	3	12
03:45 PM	0	2	0	2	0	3	0	3	3	0	0	3	8
Total Volume	7	9	0	16	2	12	0	14	12	4	0	16	46
% App. Total	43.8	56.2	0		14.3	85.7	0		75	25	0		
PHF	.438	.563	.000	.500	.500	.429	.000	.500	.600	.500	.000	.571	.821



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

N: Hanscom Drive
E/W: North Great Road (Route 2A)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 FF
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

Start Time	Hanscom Drive From North			North Great Road (Route 2A) From East			North Great Road (Route 2A) From West			Int. Total
	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	
03:00 PM	0	0	0	0	0	0	0	0	0	0
03:15 PM	0	0	0	0	0	0	0	0	0	0
03:30 PM	0	0	0	0	0	0	0	0	0	0
03:45 PM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0
04:00 PM	0	0	0	0	1	0	0	0	0	1
04:15 PM	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	1	0	0	0	0	1
Total	0	0	0	0	2	0	0	0	0	2
05:00 PM	0	0	0	0	0	0	0	0	0	0
05:15 PM	1	0	0	0	0	0	0	0	0	1
05:30 PM	0	0	0	0	1	0	0	0	0	1
05:45 PM	0	0	0	0	0	0	0	0	0	0
Total	1	0	0	0	1	0	0	0	0	2
Grand Total	1	0	0	0	3	0	0	0	0	4
Apprch %	100	0	0	0	100	0	0	0	0	
Total %	25	0	0	0	75	0	0	0	0	

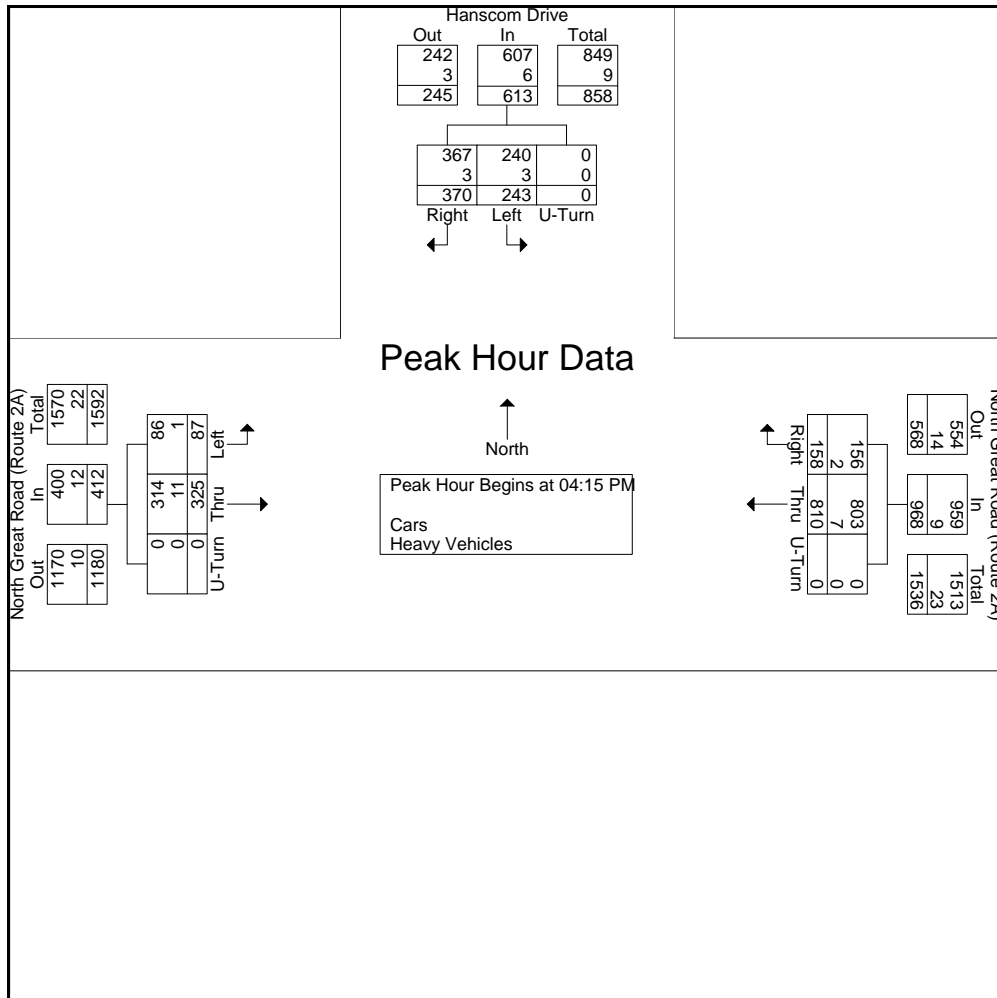
	Hanscom Drive From North				North Great Road (Route 2A) From East				North Great Road (Route 2A) From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:45 PM													
04:45 PM	0	0	0	0	0	1	0	1	0	0	0	0	1
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	1	0	0	1	0	0	0	0	0	0	0	0	1
05:30 PM	0	0	0	0	0	1	0	1	0	0	0	0	1
Total Volume	1	0	0	1	0	2	0	2	0	0	0	0	3
% App. Total	100	0	0		0	100	0		0	0	0		
PHF	.250	.000	.000	.250	.000	.500	.000	.500	.000	.000	.000	.000	.750

N: Hanscom Drive
 E/W: North Great Road (Route 2A)
 City, State: Bedford, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 FF
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

	Hanscom Drive From North				North Great Road (Route 2A) From East				North Great Road (Route 2A) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:15 PM													
04:15 PM	96	64	0	160	39	201	0	240	83	25	0	108	508
04:30 PM	104	73	0	177	33	187	0	220	77	20	0	97	494
04:45 PM	81	52	0	133	53	208	0	261	85	24	0	109	503
05:00 PM	89	54	0	143	33	214	0	247	80	18	0	98	488
Total Volume	370	243	0	613	158	810	0	968	325	87	0	412	1993
% App. Total	60.4	39.6	0		16.3	83.7	0		78.9	21.1	0		
PHF	.889	.832	.000	.866	.745	.946	.000	.927	.956	.870	.000	.945	.981
Cars	367	240	0	607	156	803	0	959	314	86	0	400	1966
% Cars	99.2	98.8	0	99.0	98.7	99.1	0	99.1	96.6	98.9	0	97.1	98.6
Heavy Vehicles	3	3	0	6	2	7	0	9	11	1	0	12	27
% Heavy Vehicles	0.8	1.2	0	1.0	1.3	0.9	0	0.9	3.4	1.1	0	2.9	1.4





PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
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S: Bedford Road
E/W: North Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 GG
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	North Great Road (Route 2A) From East			Bedford Road From South			North Great Road (Route 2A) From West			
Start Time	Thru	Left	U-Turn	Right	Left	U-Turn	Right	Thru	U-Turn	Int. Total
03:00 PM	156	72	17	16	9	0	6	62	0	338
03:15 PM	159	24	2	30	14	0	10	89	0	328
03:30 PM	201	53	0	17	17	0	8	91	0	387
03:45 PM	192	66	0	33	17	0	5	72	0	385
Total	708	215	19	96	57	0	29	314	0	1438
04:00 PM	201	74	0	25	32	0	12	73	0	417
04:15 PM	212	86	0	25	30	0	15	86	0	454
04:30 PM	190	96	0	24	31	0	6	68	0	415
04:45 PM	214	67	0	23	27	0	8	85	0	424
Total	817	323	0	97	120	0	41	312	0	1710
05:00 PM	200	100	1	22	25	0	8	73	0	429
05:15 PM	191	86	0	11	31	0	10	77	0	406
05:30 PM	201	87	0	17	28	0	21	83	0	437
05:45 PM	205	72	0	26	32	0	7	81	0	423
Total	797	345	1	76	116	0	46	314	0	1695
Grand Total	2322	883	20	269	293	0	116	940	0	4843
Apprch %	72	27.4	0.6	47.9	52.1	0	11	89	0	
Total %	47.9	18.2	0.4	5.6	6	0	2.4	19.4	0	
Cars	2293	880	20	262	292	0	113	911	0	4771
% Cars	98.8	99.7	100	97.4	99.7	0	97.4	96.9	0	98.5
Heavy Vehicles	29	3	0	7	1	0	3	29	0	72
% Heavy Vehicles	1.2	0.3	0	2.6	0.3	0	2.6	3.1	0	1.5

	North Great Road (Route 2A) From East				Bedford Road From South				North Great Road (Route 2A) From West				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:15 PM													
04:15 PM	212	86	0	298	25	30	0	55	15	86	0	101	454
04:30 PM	190	96	0	286	24	31	0	55	6	68	0	74	415
04:45 PM	214	67	0	281	23	27	0	50	8	85	0	93	424
05:00 PM	200	100	1	301	22	25	0	47	8	73	0	81	429
Total Volume	816	349	1	1166	94	113	0	207	37	312	0	349	1722
% App. Total	70	29.9	0.1		45.4	54.6	0		10.6	89.4	0		
PHF	.953	.873	.250	.968	.940	.911	.000	.941	.617	.907	.000	.864	.948
Cars	806	349	1	1156	91	113	0	204	36	304	0	340	1700
% Cars	98.8	100	100	99.1	96.8	100	0	98.6	97.3	97.4	0	97.4	98.7
Heavy Vehicles	10	0	0	10	3	0	0	3	1	8	0	9	22
% Heavy Vehicles	1.2	0	0	0.9	3.2	0	0	1.4	2.7	2.6	0	2.6	1.3

S: Bedford Road
 E/W: North Great Road (Route 2A)
 City, State: Lincoln, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 GG
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

Groups Printed- Cars										
Start Time	North Great Road (Route 2A) From East			Bedford Road From South			North Great Road (Route 2A) From West			Int. Total
	Thru	Left	U-Turn	Right	Left	U-Turn	Right	Thru	U-Turn	
03:00 PM	153	71	17	15	9	0	6	56	0	327
03:15 PM	156	23	2	28	14	0	9	84	0	316
03:30 PM	199	52	0	17	17	0	8	88	0	381
03:45 PM	189	66	0	32	16	0	4	69	0	376
Total	697	212	19	92	56	0	27	297	0	1400
04:00 PM	196	74	0	25	32	0	12	71	0	410
04:15 PM	207	86	0	23	30	0	15	82	0	443
04:30 PM	189	96	0	23	31	0	5	67	0	411
04:45 PM	210	67	0	23	27	0	8	84	0	419
Total	802	323	0	94	120	0	40	304	0	1683
05:00 PM	200	100	1	22	25	0	8	71	0	427
05:15 PM	190	86	0	11	31	0	10	77	0	405
05:30 PM	200	87	0	17	28	0	21	81	0	434
05:45 PM	204	72	0	26	32	0	7	81	0	422
Total	794	345	1	76	116	0	46	310	0	1688
Grand Total	2293	880	20	262	292	0	113	911	0	4771
Apprch %	71.8	27.6	0.6	47.3	52.7	0	11	89	0	
Total %	48.1	18.4	0.4	5.5	6.1	0	2.4	19.1	0	

	North Great Road (Route 2A) From East				Bedford Road From South				North Great Road (Route 2A) From West				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:15 PM													
04:15 PM	207	86	0	293	23	30	0	53	15	82	0	97	443
04:30 PM	189	96	0	285	23	31	0	54	5	67	0	72	411
04:45 PM	210	67	0	277	23	27	0	50	8	84	0	92	419
05:00 PM	200	100	1	301	22	25	0	47	8	71	0	79	427
Total Volume	806	349	1	1156	91	113	0	204	36	304	0	340	1700
% App. Total	69.7	30.2	0.1		44.6	55.4	0		10.6	89.4	0		
PHF	.960	.873	.250	.960	.989	.911	.000	.944	.600	.905	.000	.876	.959



PRECISION
D A T A
INDUSTRIES, LLC

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Email: datarequests@pdillc.com

S: Bedford Road
E/W: North Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 GG
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

Start Time	North Great Road (Route 2A) From East			Bedford Road From South			North Great Road (Route 2A) From West			Int. Total
	Thru	Left	U-Turn	Right	Left	U-Turn	Right	Thru	U-Turn	
03:00 PM	3	1	0	1	0	0	0	6	0	11
03:15 PM	3	1	0	2	0	0	1	5	0	12
03:30 PM	2	1	0	0	0	0	0	3	0	6
03:45 PM	3	0	0	1	1	0	1	3	0	9
Total	11	3	0	4	1	0	2	17	0	38
04:00 PM	5	0	0	0	0	0	0	2	0	7
04:15 PM	5	0	0	2	0	0	0	4	0	11
04:30 PM	1	0	0	1	0	0	1	1	0	4
04:45 PM	4	0	0	0	0	0	0	1	0	5
Total	15	0	0	3	0	0	1	8	0	27
05:00 PM	0	0	0	0	0	0	0	2	0	2
05:15 PM	1	0	0	0	0	0	0	0	0	1
05:30 PM	1	0	0	0	0	0	0	2	0	3
05:45 PM	1	0	0	0	0	0	0	0	0	1
Total	3	0	0	0	0	0	0	4	0	7
Grand Total	29	3	0	7	1	0	3	29	0	72
Apprch %	90.6	9.4	0	87.5	12.5	0	9.4	90.6	0	
Total %	40.3	4.2	0	9.7	1.4	0	4.2	40.3	0	

	North Great Road (Route 2A) From East				Bedford Road From South				North Great Road (Route 2A) From West				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 03:00 PM													
03:00 PM	3	1	0	4	1	0	0	1	0	6	0	6	11
03:15 PM	3	1	0	4	2	0	0	2	1	5	0	6	12
03:30 PM	2	1	0	3	0	0	0	0	0	3	0	3	6
03:45 PM	3	0	0	3	1	1	0	2	1	3	0	4	9
Total Volume	11	3	0	14	4	1	0	5	2	17	0	19	38
% App. Total	78.6	21.4	0		80	20	0		10.5	89.5	0		
PHF	.917	.750	.000	.875	.500	.250	.000	.625	.500	.708	.000	.792	.792



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
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Email: datarequests@pdillc.com

S: Bedford Road
E/W: North Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 GG
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

	North Great Road (Route 2A) From East			Bedford Road From South			North Great Road (Route 2A) From West			
Start Time	Thru	Left	Peds	Right	Left	Peds	Right	Thru	Peds	Int. Total
03:00 PM	0	0	0	0	0	0	0	0	0	0
03:15 PM	1	0	0	0	0	0	0	0	0	1
03:30 PM	3	0	0	0	0	0	0	0	0	3
03:45 PM	0	0	0	0	1	0	0	0	0	1
Total	4	0	0	0	1	0	0	0	0	5
04:00 PM	1	0	0	0	0	0	0	0	0	1
04:15 PM	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	1	0	0	0	0	0	0	0	1
Total	1	1	0	0	0	0	0	0	0	2
05:00 PM	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	1	0	0	0	0	0	0	0	1
05:30 PM	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0
Total	0	1	0	0	0	0	0	0	0	1
Grand Total	5	2	0	0	1	0	0	0	0	8
Apprch %	71.4	28.6	0	0	100	0	0	0	0	
Total %	62.5	25	0	0	12.5	0	0	0	0	

	North Great Road (Route 2A) From East				Bedford Road From South				North Great Road (Route 2A) From West				
Start Time	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 03:15 PM													
03:15 PM	1	0	0	1	0	0	0	0	0	0	0	0	1
03:30 PM	3	0	0	3	0	0	0	0	0	0	0	0	3
03:45 PM	0	0	0	0	0	1	0	1	0	0	0	0	1
04:00 PM	1	0	0	1	0	0	0	0	0	0	0	0	1
Total Volume	5	0	0	5	0	1	0	1	0	0	0	0	6
% App. Total	100	0	0		0	100	0		0	0	0		
PHF	.417	.000	.000	.417	.000	.250	.000	.250	.000	.000	.000	.000	.500



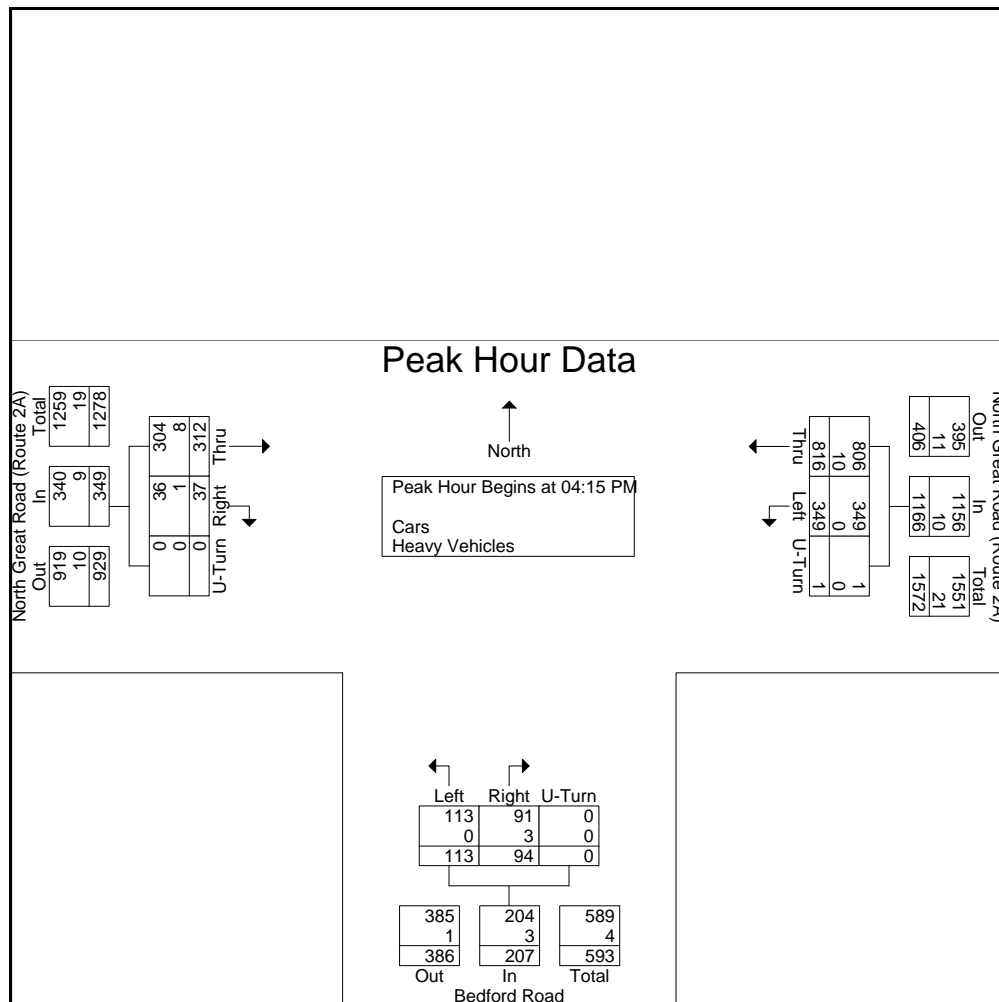
PRECISION
D A T A
INDUSTRIES, LLC

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S: Bedford Road
E/W: North Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 GG
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

	North Great Road (Route 2A) From East				Bedford Road From South				North Great Road (Route 2A) From West				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:15 PM													
04:15 PM	212	86	0	298	25	30	0	55	15	86	0	101	454
04:30 PM	190	96	0	286	24	31	0	55	6	68	0	74	415
04:45 PM	214	67	0	281	23	27	0	50	8	85	0	93	424
05:00 PM	200	100	1	301	22	25	0	47	8	73	0	81	429
Total Volume	816	349	1	1166	94	113	0	207	37	312	0	349	1722
% App. Total	70	29.9	0.1		45.4	54.6	0		10.6	89.4	0		
PHF	.953	.873	.250	.968	.940	.911	.000	.941	.617	.907	.000	.864	.948
Cars	806	349	1	1156	91	113	0	204	36	304	0	340	1700
% Cars	98.8	100	100	99.1	96.8	100	0	98.6	97.3	97.4	0	97.4	98.7
Heavy Vehicles	10	0	0	10	3	0	0	3	1	8	0	9	22
% Heavy Vehicles	1.2	0	0	0.9	3.2	0	0	1.4	2.7	2.6	0	2.6	1.3





PRECISION
D A T A
INDUSTRIES, LLC

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N/S: Lexington Road (Rt 2A)/ Brooks Road
E/W: N.Great Rd (Rt 2A)/ Bypass Road
City, State: Lincoln, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 HH
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Lexington Road (Route 2A) From North				North Great Road (Route 2A) From East				Brooks Road From South				Bypass Road From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
03:00 PM	3	0	27	0	56	106	1	0	2	0	1	0	1	52	2	0	251
03:15 PM	2	0	28	0	60	115	3	0	2	0	1	0	1	66	0	0	278
03:30 PM	5	0	35	0	89	123	2	0	1	0	0	0	0	55	0	0	310
03:45 PM	6	0	27	0	76	138	1	0	0	0	0	0	0	60	2	0	310
Total	16	0	117	0	281	482	7	0	5	0	2	0	2	233	4	0	1149
04:00 PM	5	1	38	0	103	129	3	0	2	1	0	0	0	48	1	0	331
04:15 PM	3	1	28	0	90	145	2	0	2	3	0	0	2	61	0	0	337
04:30 PM	4	1	25	0	92	139	4	0	0	0	0	0	1	59	2	0	327
04:45 PM	4	1	23	0	90	143	3	0	1	0	1	0	1	64	3	0	334
Total	16	4	114	0	375	556	12	0	5	4	1	0	4	232	6	0	1329
05:00 PM	5	1	35	0	113	123	0	0	1	0	0	0	0	44	14	0	336
05:15 PM	3	0	35	0	100	115	0	0	0	0	0	0	0	61	5	0	319
05:30 PM	5	2	35	0	106	127	0	0	2	0	0	0	1	58	4	0	340
05:45 PM	4	0	31	0	98	144	0	0	3	0	0	0	2	61	7	0	350
Total	17	3	136	0	417	509	0	0	6	0	0	0	3	224	30	0	1345
Grand Total	49	7	367	0	1073	1547	19	0	16	4	3	0	9	689	40	0	3823
Apprch %	11.6	1.7	86.8	0	40.7	58.6	0.7	0	69.6	17.4	13	0	1.2	93.4	5.4	0	
Total %	1.3	0.2	9.6	0	28.1	40.5	0.5	0	0.4	0.1	0.1	0	0.2	18	1	0	
Cars	49	6	359	0	1069	1520	17	0	15	4	2	0	8	665	40	0	3754
% Cars	100	85.7	97.8	0	99.6	98.3	89.5	0	93.8	100	66.7	0	88.9	96.5	100	0	98.2
Heavy Vehicles	0	1	8	0	4	27	2	0	1	0	1	0	1	24	0	0	69
% Heavy Vehicles	0	14.3	2.2	0	0.4	1.7	10.5	0	6.2	0	33.3	0	11.1	3.5	0	0	1.8

	Lexington Road (Route 2A) From North					North Great Road (Route 2A) From East					Brooks Road From South					Bypass Road From West					Int. Total
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
05:00 PM	5	1	35	0	41	113	123	0	0	236	1	0	0	0	1	0	44	14	0	58	336
05:15 PM	3	0	35	0	38	100	115	0	0	215	0	0	0	0	0	0	61	5	0	66	319
05:30 PM	5	2	35	0	42	106	127	0	0	233	2	0	0	0	2	1	58	4	0	63	340
05:45 PM	4	0	31	0	35	98	144	0	0	242	3	0	0	0	3	2	61	7	0	70	350
Total Volume	17	3	136	0	156	417	509	0	0	926	6	0	0	0	6	3	224	30	0	257	1345
% App. Total	10.9	1.9	87.2	0		45	55	0	0		100	0	0	0		1.2	87.2	11.7	0		
PHF	.850	.375	.971	.000	.929	.923	.884	.000	.000	.957	.500	.000	.000	.000	.500	.375	.918	.536	.000	.918	.961
Cars	17	3	136	0	156	417	506	0	0	923	6	0	0	0	6	3	220	30	0	253	1338
% Cars	100	100	100	0	100	100	99.4	0	0	99.7	100	0	0	0	100	100	98.2	100	0	98.4	99.5
Heavy Vehicles	0	0	0	0	0	0	3	0	0	3	0	0	0	0	0	0	4	0	0	4	7
% Heavy Vehicles	0	0	0	0	0	0	0.6	0	0	0.3	0	0	0	0	0	0	1.8	0	0	1.6	0.5

Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1
Peak Hour for Entire Intersection Begins at 05:00 PM

N/S: Lexington Road (Rt 2A)/ Brooks Road
 E/W: N.Great Rd (Rt 2A)/ Bypass Road
 City, State: Lincoln, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 HH
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

Groups Printed- Cars

	Lexington Road (Route 2A) From North				North Great Road (Route 2A) From East				Brooks Road From South				Bypass Road From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
03:00 PM	3	0	24	0	56	104	1	0	1	0	1	0	0	48	2	0	240
03:15 PM	2	0	26	0	60	112	2	0	2	0	0	0	1	64	0	0	269
03:30 PM	5	0	34	0	88	121	2	0	1	0	0	0	0	52	0	0	303
03:45 PM	6	0	27	0	75	134	1	0	0	0	0	0	0	58	2	0	303
Total	16	0	111	0	279	471	6	0	4	0	1	0	1	222	4	0	1115
04:00 PM	5	1	38	0	102	125	2	0	2	1	0	0	0	44	1	0	321
04:15 PM	3	1	27	0	89	140	2	0	2	3	0	0	2	58	0	0	327
04:30 PM	4	1	24	0	92	138	4	0	0	0	0	0	1	58	2	0	324
04:45 PM	4	0	23	0	90	140	3	0	1	0	1	0	1	63	3	0	329
Total	16	3	112	0	373	543	11	0	5	4	1	0	4	223	6	0	1301
05:00 PM	5	1	35	0	113	122	0	0	1	0	0	0	0	42	14	0	333
05:15 PM	3	0	35	0	100	115	0	0	0	0	0	0	0	61	5	0	319
05:30 PM	5	2	35	0	106	126	0	0	2	0	0	0	1	56	4	0	337
05:45 PM	4	0	31	0	98	143	0	0	3	0	0	0	2	61	7	0	349
Total	17	3	136	0	417	506	0	0	6	0	0	0	3	220	30	0	1338
Grand Total	49	6	359	0	1069	1520	17	0	15	4	2	0	8	665	40	0	3754
Apprch %	11.8	1.4	86.7	0	41	58.3	0.7	0	71.4	19	9.5	0	1.1	93.3	5.6	0	
Total %	1.3	0.2	9.6	0	28.5	40.5	0.5	0	0.4	0.1	0.1	0	0.2	17.7	1.1	0	

	Lexington Road (Route 2A) From North					North Great Road (Route 2A) From East					Brooks Road From South					Bypass Road From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 05:00 PM																					
05:00 PM	5	1	35	0	41	113	122	0	0	235	1	0	0	0	1	0	42	14	0	56	333
05:15 PM	3	0	35	0	38	100	115	0	0	215	0	0	0	0	0	0	61	5	0	66	319
05:30 PM	5	2	35	0	42	106	126	0	0	232	2	0	0	0	2	1	56	4	0	61	337
05:45 PM	4	0	31	0	35	98	143	0	0	241	3	0	0	0	3	2	61	7	0	70	349
Total Volume	17	3	136	0	156	417	506	0	0	923	6	0	0	0	6	3	220	30	0	253	1338
% App. Total	10.9	1.9	87.2	0		45.2	54.8	0	0		100	0	0	0		1.2	87	11.9	0		
PHF	.850	.375	.971	.000	.929	.923	.885	.000	.000	.957	.500	.000	.000	.000	.500	.375	.902	.536	.000	.904	.958



PRECISION
D A T A
INDUSTRIES, LLC

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Email: datarequests@pdillc.com

N/S: Lexington Road (Rt 2A)/ Brooks Road
E/W: N.Great Rd (Rt 2A)/ Bypass Road
City, State: Lincoln, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 HH
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

	Lexington Road (Route 2A) From North				North Great Road (Route 2A) From East				Brooks Road From South				Bypass Road From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
03:00 PM	0	0	3	0	0	2	0	0	1	0	0	0	1	4	0	0	11
03:15 PM	0	0	2	0	0	3	1	0	0	0	1	0	0	2	0	0	9
03:30 PM	0	0	1	0	1	2	0	0	0	0	0	0	0	3	0	0	7
03:45 PM	0	0	0	0	1	4	0	0	0	0	0	0	0	2	0	0	7
Total	0	0	6	0	2	11	1	0	1	0	1	0	1	11	0	0	34
04:00 PM	0	0	0	0	1	4	1	0	0	0	0	0	0	4	0	0	10
04:15 PM	0	0	1	0	1	5	0	0	0	0	0	0	0	3	0	0	10
04:30 PM	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	3
04:45 PM	0	1	0	0	0	3	0	0	0	0	0	0	0	1	0	0	5
Total	0	1	2	0	2	13	1	0	0	0	0	0	0	9	0	0	28
05:00 PM	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	3
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	3
05:45 PM	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Total	0	0	0	0	0	3	0	0	0	0	0	0	0	4	0	0	7
Grand Total	0	1	8	0	4	27	2	0	1	0	1	0	1	24	0	0	69
Apprch %	0	11.1	88.9	0	12.1	81.8	6.1	0	50	0	50	0	4	96	0	0	
Total %	0	1.4	11.6	0	5.8	39.1	2.9	0	1.4	0	1.4	0	1.4	34.8	0	0	

	Lexington Road (Route 2A) From North					North Great Road (Route 2A) From East					Brooks Road From South					Bypass Road From West					Int. Total
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 03:00 PM																					
03:00 PM	0	0	3	0	3	0	2	0	0	2	1	0	0	0	1	1	4	0	0	5	11
03:15 PM	0	0	2	0	2	0	3	1	0	4	0	0	1	0	1	0	2	0	0	2	9
03:30 PM	0	0	1	0	1	1	2	0	0	3	0	0	0	0	0	0	3	0	0	3	7
03:45 PM	0	0	0	0	0	1	4	0	0	5	0	0	0	0	0	0	2	0	0	2	7
Total Volume	0	0	6	0	6	2	11	1	0	14	1	0	1	0	2	1	11	0	0	12	34
% App. Total	0	0	100	0		14.3	78.6	7.1	0		50	0	50	0		8.3	91.7	0	0		
PHF	.000	.000	.500	.000	.500	.500	.688	.250	.000	.700	.250	.000	.250	.000	.500	.250	.688	.000	.000	.600	.773

N/S: Lexington Road (Rt 2A)/ Brooks Road
E/W: N.Great Rd (Rt 2A)/ Bypass Road
City, State: Lincoln, MA
Client: Toole Engineering/ C. Fink



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File Name : 123082 HH
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

[illegible][illegible]



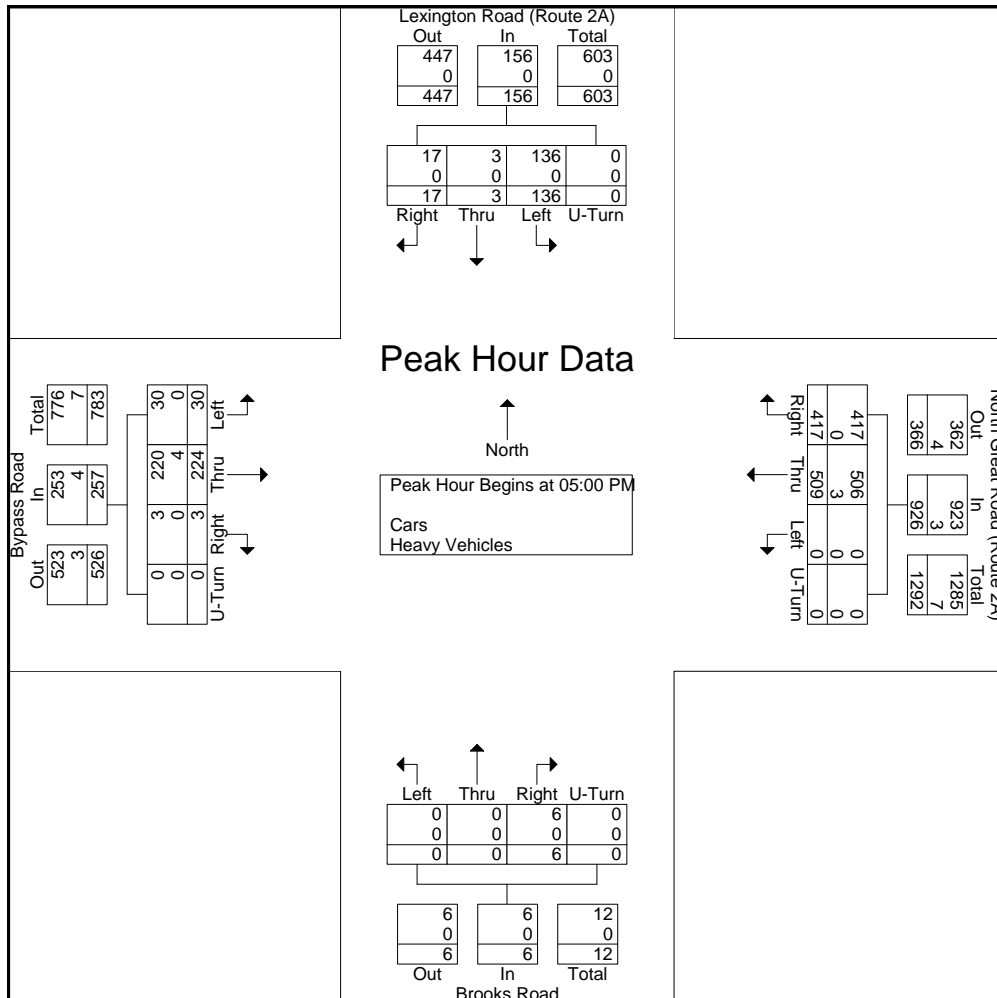
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City, State: Lincoln, MA
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File Name : 123082 HH
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Page No : 1

	Lexington Road (Route 2A) From North					North Great Road (Route 2A) From East					Brooks Road From South					Bypass Road From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 05:00 PM																					
05:00 PM	5	1	35	0	41	113	123	0	0	236	1	0	0	0	1	0	44	14	0	58	336
05:15 PM	3	0	35	0	38	100	115	0	0	215	0	0	0	0	0	0	61	5	0	66	319
05:30 PM	5	2	35	0	42	106	127	0	0	233	2	0	0	0	2	1	58	4	0	63	340
05:45 PM	4	0	31	0	35	98	144	0	0	242	3	0	0	0	3	2	61	7	0	70	350
Total Volume	17	3	136	0	156	417	509	0	0	926	6	0	0	0	6	3	224	30	0	257	1345
% App. Total	10.9	1.9	87.2	0		45	55	0	0		100	0	0	0		1.2	87.2	11.7	0		
PHF	.850	.375	.971	.000	.929	.923	.884	.000	.000	.957	.500	.000	.000	.000	.500	.375	.918	.536	.000	.918	.961
Cars	17	3	136	0	156	417	506	0	0	923	6	0	0	0	6	3	220	30	0	253	1338
% Cars	100	100	100	0	100	100	99.4	0	0	99.7	100	0	0	0	100	100	98.2	100	0	98.4	99.5
Heavy Vehicles	0	0	0	0	0	0	3	0	0	3	0	0	0	0	0	0	4	0	0	4	7
% Heavy Vehicles	0	0	0	0	0	0	0.6	0	0	0.3	0	0	0	0	0	0	1.8	0	0	1.6	0.5



N: Old Bedford Road
 E/W: Lexington Road
 City, State: Concord, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 II
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Old Bedford Road From North			Lexington Road From East			Lexington Road From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
03:00 PM	42	12	0	8	48	0	19	31	0	160
03:15 PM	41	9	0	18	49	0	23	32	0	172
03:30 PM	42	17	0	19	64	0	27	40	1	210
03:45 PM	54	14	0	27	64	0	21	37	0	217
Total	179	52	0	72	225	0	90	140	1	759
04:00 PM	55	17	0	21	81	0	23	35	0	232
04:15 PM	57	11	0	26	77	0	15	25	0	211
04:30 PM	40	9	1	32	67	0	25	26	0	200
04:45 PM	55	20	0	33	60	0	11	19	0	198
Total	207	57	1	112	285	0	74	105	0	841
05:00 PM	68	7	0	46	80	0	24	31	0	256
05:15 PM	40	20	0	38	70	0	25	27	0	220
05:30 PM	48	10	0	34	78	0	19	31	1	221
05:45 PM	53	11	0	36	64	0	29	26	0	219
Total	209	48	0	154	292	0	97	115	1	916
Grand Total	595	157	1	338	802	0	261	360	2	2516
Apprch %	79	20.8	0.1	29.6	70.4	0	41.9	57.8	0.3	
Total %	23.6	6.2	0	13.4	31.9	0	10.4	14.3	0.1	
Cars	588	154	0	336	799	0	254	350	2	2483
% Cars	98.8	98.1	0	99.4	99.6	0	97.3	97.2	100	98.7
Heavy Vehicles	7	3	1	2	3	0	7	10	0	33
% Heavy Vehicles	1.2	1.9	100	0.6	0.4	0	2.7	2.8	0	1.3

	Old Bedford Road From North				Lexington Road From East				Lexington Road From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 05:00 PM													
05:00 PM	68	7	0	75	46	80	0	126	24	31	0	55	256
05:15 PM	40	20	0	60	38	70	0	108	25	27	0	52	220
05:30 PM	48	10	0	58	34	78	0	112	19	31	1	51	221
05:45 PM	53	11	0	64	36	64	0	100	29	26	0	55	219
Total Volume	209	48	0	257	154	292	0	446	97	115	1	213	916
% App. Total	81.3	18.7	0		34.5	65.5	0		45.5	54	0.5		
PHF	.768	.600	.000	.857	.837	.913	.000	.885	.836	.927	.250	.968	.895
Cars	207	48	0	255	154	291	0	445	97	112	1	210	910
% Cars	99.0	100	0	99.2	100	99.7	0	99.8	100	97.4	100	98.6	99.3
Heavy Vehicles	2	0	0	2	0	1	0	1	0	3	0	3	6
% Heavy Vehicles	1.0	0	0	0.8	0	0.3	0	0.2	0	2.6	0	1.4	0.7



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N: Old Bedford Road
E/W: Lexington Road
City, State: Concord, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 II
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars

	Old Bedford Road From North			Lexington Road From East			Lexington Road From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
03:00 PM	42	11	0	8	48	0	19	31	0	159
03:15 PM	40	8	0	18	49	0	22	31	0	168
03:30 PM	42	17	0	19	64	0	24	38	1	205
03:45 PM	52	14	0	27	63	0	21	37	0	214
Total	176	50	0	72	224	0	86	137	1	746
04:00 PM	55	17	0	19	81	0	23	34	0	229
04:15 PM	57	11	0	26	76	0	13	24	0	207
04:30 PM	40	9	0	32	67	0	24	24	0	196
04:45 PM	53	19	0	33	60	0	11	19	0	195
Total	205	56	0	110	284	0	71	101	0	827
05:00 PM	67	7	0	46	80	0	24	30	0	254
05:15 PM	40	20	0	38	70	0	25	26	0	219
05:30 PM	47	10	0	34	77	0	19	30	1	218
05:45 PM	53	11	0	36	64	0	29	26	0	219
Total	207	48	0	154	291	0	97	112	1	910
Grand Total	588	154	0	336	799	0	254	350	2	2483
Apprch %	79.2	20.8	0	29.6	70.4	0	41.9	57.8	0.3	
Total %	23.7	6.2	0	13.5	32.2	0	10.2	14.1	0.1	

	Old Bedford Road From North				Lexington Road From East				Lexington Road From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 05:00 PM													
05:00 PM	67	7	0	74	46	80	0	126	24	30	0	54	254
05:15 PM	40	20	0	60	38	70	0	108	25	26	0	51	219
05:30 PM	47	10	0	57	34	77	0	111	19	30	1	50	218
05:45 PM	53	11	0	64	36	64	0	100	29	26	0	55	219
Total Volume	207	48	0	255	154	291	0	445	97	112	1	210	910
% App. Total	81.2	18.8	0		34.6	65.4	0		46.2	53.3	0.5		
PHF	.772	.600	.000	.861	.837	.909	.000	.883	.836	.933	.250	.955	.896



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File Name : 123082 II
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

	Old Bedford Road From North			Lexington Road From East			Lexington Road From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
03:00 PM	0	1	0	0	0	0	0	0	0	1
03:15 PM	1	1	0	0	0	0	1	1	0	4
03:30 PM	0	0	0	0	0	0	3	2	0	5
03:45 PM	2	0	0	0	1	0	0	0	0	3
Total	3	2	0	0	1	0	4	3	0	13
04:00 PM	0	0	0	2	0	0	0	1	0	3
04:15 PM	0	0	0	0	1	0	2	1	0	4
04:30 PM	0	0	1	0	0	0	1	2	0	4
04:45 PM	2	1	0	0	0	0	0	0	0	3
Total	2	1	1	2	1	0	3	4	0	14
05:00 PM	1	0	0	0	0	0	0	1	0	2
05:15 PM	0	0	0	0	0	0	0	1	0	1
05:30 PM	1	0	0	0	1	0	0	1	0	3
05:45 PM	0	0	0	0	0	0	0	0	0	0
Total	2	0	0	0	1	0	0	3	0	6
Grand Total	7	3	1	2	3	0	7	10	0	33
Apprch %	63.6	27.3	9.1	40	60	0	41.2	58.8	0	
Total %	21.2	9.1	3	6.1	9.1	0	21.2	30.3	0	

	Old Bedford Road From North				Lexington Road From East				Lexington Road From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 03:15 PM													
03:15 PM	1	1	0	2	0	0	0	0	1	1	0	2	4
03:30 PM	0	0	0	0	0	0	0	0	3	2	0	5	5
03:45 PM	2	0	0	2	0	1	0	1	0	0	0	0	3
04:00 PM	0	0	0	0	2	0	0	2	0	1	0	1	3
Total Volume	3	1	0	4	2	1	0	3	4	4	0	8	15
% App. Total	75	25	0		66.7	33.3	0		50	50	0		
PHF	.375	.250	.000	.500	.250	.250	.000	.375	.333	.500	.000	.400	.750



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Page No : 1

Groups Printed- Peds and Bicycles

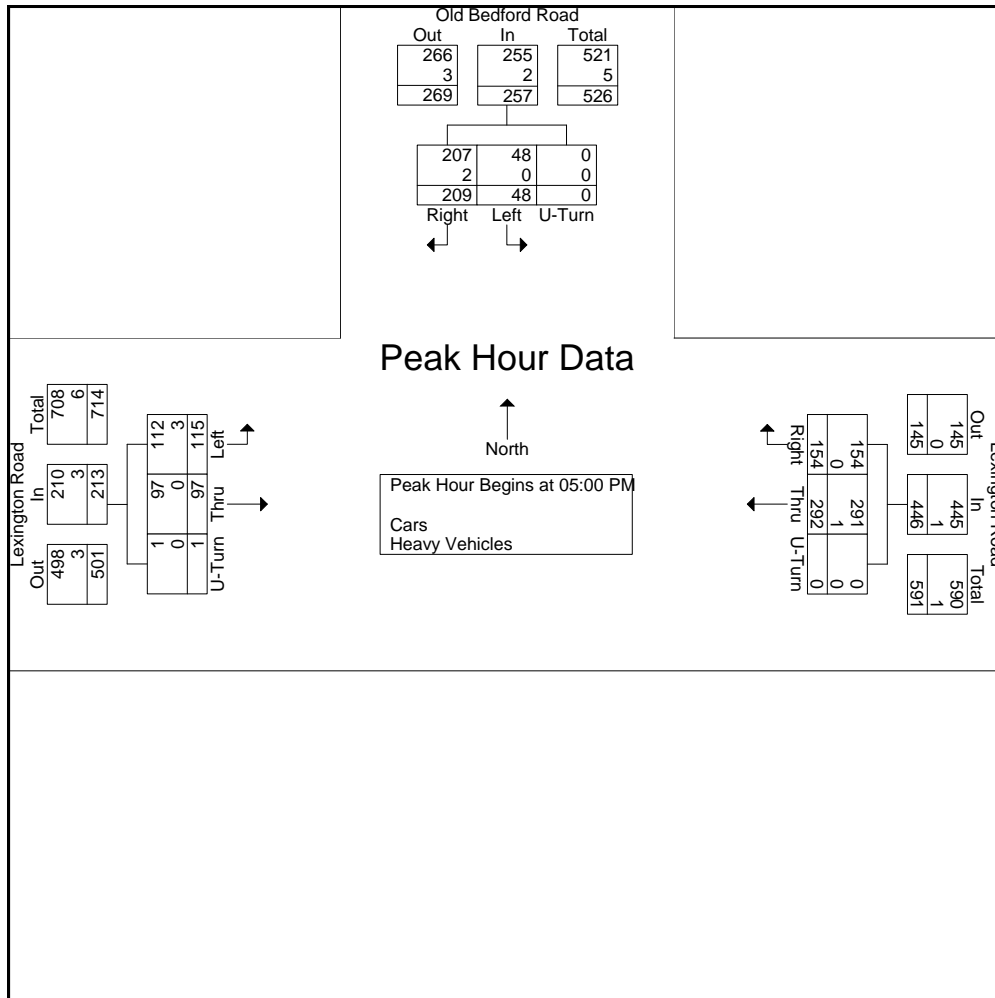
[illegible][illegible]

N: Old Bedford Road
 E/W: Lexington Road
 City, State: Concord, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 II
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

	Old Bedford Road From North				Lexington Road From East				Lexington Road From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 05:00 PM													
05:00 PM	68	7	0	75	46	80	0	126	24	31	0	55	256
05:15 PM	40	20	0	60	38	70	0	108	25	27	0	52	220
05:30 PM	48	10	0	58	34	78	0	112	19	31	1	51	221
05:45 PM	53	11	0	64	36	64	0	100	29	26	0	55	219
Total Volume	209	48	0	257	154	292	0	446	97	115	1	213	916
% App. Total	81.3	18.7	0		34.5	65.5	0		45.5	54	0.5		
PHF	.768	.600	.000	.857	.837	.913	.000	.885	.836	.927	.250	.968	.895
Cars	207	48	0	255	154	291	0	445	97	112	1	210	910
% Cars	99.0	100	0	99.2	100	99.7	0	99.8	100	97.4	100	98.6	99.3
Heavy Vehicles	2	0	0	2	0	1	0	1	0	3	0	3	6
% Heavy Vehicles	1.0	0	0	0.8	0	0.3	0	0.2	0	2.6	0	1.4	0.7





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N/S: Old Bedford Road
E/W: Virginia Road
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 JJ
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Old Bedford Road From North			Virginia Road From East			Old Bedford Road From South			
Start Time	Thru	Left	U-Turn	Right	Left	U-Turn	Right	Thru	U-Turn	Int. Total
03:00 PM	30	5	0	44	27	0	8	31	0	145
03:15 PM	21	7	0	23	25	0	8	41	0	125
03:30 PM	36	3	0	34	23	0	11	40	0	147
03:45 PM	36	7	0	25	27	0	9	54	0	158
Total	123	22	0	126	102	0	36	166	0	575
04:00 PM	37	3	0	55	30	0	6	56	0	187
04:15 PM	30	9	0	44	28	0	6	47	0	164
04:30 PM	24	5	0	80	26	0	12	45	0	192
04:45 PM	36	3	0	69	39	0	5	54	0	206
Total	127	20	0	248	123	0	29	202	0	749
05:00 PM	34	3	0	60	37	0	10	63	0	207
05:15 PM	36	4	0	84	30	0	42	20	4	220
05:30 PM	29	5	0	55	38	0	12	48	0	187
05:45 PM	33	1	0	53	24	1	8	53	0	173
Total	132	13	0	252	129	1	72	184	4	787
Grand Total	382	55	0	626	354	1	137	552	4	2111
Apprch %	87.4	12.6	0	63.8	36.1	0.1	19.8	79.7	0.6	
Total %	18.1	2.6	0	29.7	16.8	0	6.5	26.1	0.2	
Cars	377	54	0	626	350	1	131	546	4	2089
% Cars	98.7	98.2	0	100	98.9	100	95.6	98.9	100	99
Heavy Vehicles	5	1	0	0	4	0	6	6	0	22
% Heavy Vehicles	1.3	1.8	0	0	1.1	0	4.4	1.1	0	1

	Old Bedford Road From North				Virginia Road From East				Old Bedford Road From South				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:30 PM													
04:30 PM	24	5	0	29	80	26	0	106	12	45	0	57	192
04:45 PM	36	3	0	39	69	39	0	108	5	54	0	59	206
05:00 PM	34	3	0	37	60	37	0	97	10	63	0	73	207
05:15 PM	36	4	0	40	84	30	0	114	42	20	4	66	220
Total Volume	130	15	0	145	293	132	0	425	69	182	4	255	825
% App. Total	89.7	10.3	0		68.9	31.1	0		27.1	71.4	1.6		
PHF	.903	.750	.000	.906	.872	.846	.000	.932	.411	.722	.250	.873	.938
Cars	129	15	0	144	293	131	0	424	67	181	4	252	820
% Cars	99.2	100	0	99.3	100	99.2	0	99.8	97.1	99.5	100	98.8	99.4
Heavy Vehicles	1	0	0	1	0	1	0	1	2	1	0	3	5
% Heavy Vehicles	0.8	0	0	0.7	0	0.8	0	0.2	2.9	0.5	0	1.2	0.6



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N/S: Old Bedford Road
E/W: Virginia Road
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 JJ
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars

Start Time	Old Bedford Road From North			Virginia Road From East			Old Bedford Road From South			Int. Total
	Thru	Left	U-Turn	Right	Left	U-Turn	Right	Thru	U-Turn	
03:00 PM	28	5	0	44	27	0	8	31	0	143
03:15 PM	19	7	0	23	25	0	8	41	0	123
03:30 PM	36	3	0	34	23	0	9	39	0	144
03:45 PM	36	7	0	25	25	0	8	54	0	155
Total	119	22	0	126	100	0	33	165	0	565
04:00 PM	37	2	0	55	30	0	6	53	0	183
04:15 PM	30	9	0	44	28	0	6	46	0	163
04:30 PM	23	5	0	80	26	0	12	45	0	191
04:45 PM	36	3	0	69	38	0	5	54	0	205
Total	126	19	0	248	122	0	29	198	0	742
05:00 PM	34	3	0	60	37	0	9	63	0	206
05:15 PM	36	4	0	84	30	0	41	19	4	218
05:30 PM	29	5	0	55	37	0	11	48	0	185
05:45 PM	33	1	0	53	24	1	8	53	0	173
Total	132	13	0	252	128	1	69	183	4	782
Grand Total	377	54	0	626	350	1	131	546	4	2089
Apprch %	87.5	12.5	0	64.1	35.8	0.1	19.2	80.2	0.6	
Total %	18	2.6	0	30	16.8	0	6.3	26.1	0.2	

	Old Bedford Road From North				Virginia Road From East				Old Bedford Road From South				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:30 PM													
04:30 PM	23	5	0	28	80	26	0	106	12	45	0	57	191
04:45 PM	36	3	0	39	69	38	0	107	5	54	0	59	205
05:00 PM	34	3	0	37	60	37	0	97	9	63	0	72	206
05:15 PM	36	4	0	40	84	30	0	114	41	19	4	64	218
Total Volume	129	15	0	144	293	131	0	424	67	181	4	252	820
% App. Total	89.6	10.4	0		69.1	30.9	0		26.6	71.8	1.6		
PHF	.896	.750	.000	.900	.872	.862	.000	.930	.409	.718	.250	.875	.940



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N/S: Old Bedford Road
E/W: Virginia Road
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 JJ
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

	Old Bedford Road From North			Virginia Road From East			Old Bedford Road From South			
Start Time	Thru	Left	U-Turn	Right	Left	U-Turn	Right	Thru	U-Turn	Int. Total
03:00 PM	2	0	0	0	0	0	0	0	0	2
03:15 PM	2	0	0	0	0	0	0	0	0	2
03:30 PM	0	0	0	0	0	0	2	1	0	3
03:45 PM	0	0	0	0	2	0	1	0	0	3
Total	4	0	0	0	2	0	3	1	0	10
04:00 PM	0	1	0	0	0	0	0	3	0	4
04:15 PM	0	0	0	0	0	0	0	1	0	1
04:30 PM	1	0	0	0	0	0	0	0	0	1
04:45 PM	0	0	0	0	1	0	0	0	0	1
Total	1	1	0	0	1	0	0	4	0	7
05:00 PM	0	0	0	0	0	0	1	0	0	1
05:15 PM	0	0	0	0	0	0	1	1	0	2
05:30 PM	0	0	0	0	1	0	1	0	0	2
05:45 PM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	1	0	3	1	0	5
Grand Total	5	1	0	0	4	0	6	6	0	22
Apprch %	83.3	16.7	0	0	100	0	50	50	0	
Total %	22.7	4.5	0	0	18.2	0	27.3	27.3	0	

	Old Bedford Road From North				Virginia Road From East				Old Bedford Road From South				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 03:15 PM													
03:15 PM	2	0	0	2	0	0	0	0	0	0	0	0	2
03:30 PM	0	0	0	0	0	0	0	0	2	1	0	3	3
03:45 PM	0	0	0	0	0	2	0	2	1	0	0	1	3
04:00 PM	0	1	0	1	0	0	0	0	0	3	0	3	4
Total Volume	2	1	0	3	0	2	0	2	3	4	0	7	12
% App. Total	66.7	33.3	0		0	100	0		42.9	57.1	0		
PHF	.250	.250	.000	.375	.000	.250	.000	.250	.375	.333	.000	.583	.750



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E/W: Virginia Road
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 JJ
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

Start Time	Old Bedford Road From North			Virginia Road From East			Old Bedford Road From South			Int. Total
	Thru	Left	Peds	Right	Left	Peds	Right	Thru	Peds	
03:00 PM	0	0	0	0	0	0	0	0	0	0
03:15 PM	0	0	0	0	0	0	0	0	0	0
03:30 PM	0	0	0	0	0	1	0	0	0	1
03:45 PM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	1	0	0	0	1
04:00 PM	0	0	0	0	0	0	0	1	0	1
04:15 PM	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	1	0	1
05:00 PM	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	0	0	0	1	0	1	0	2
Apprch %	0	0	0	0	0	100	0	100	0	
Total %	0	0	0	0	0	50	0	50	0	

	Old Bedford Road From North				Virginia Road From East				Old Bedford Road From South				
Start Time	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 03:15 PM													
03:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
03:30 PM	0	0	0	0	0	0	1	1	0	0	0	0	1
03:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00 PM	0	0	0	0	0	0	0	0	0	1	0	1	1
Total Volume	0	0	0	0	0	0	1	1	0	1	0	1	2
% App. Total	0	0	0		0	0	100		0	100	0		
PHF	.000	.000	.000	.000	.000	.000	.250	.250	.000	.250	.000	.250	.500



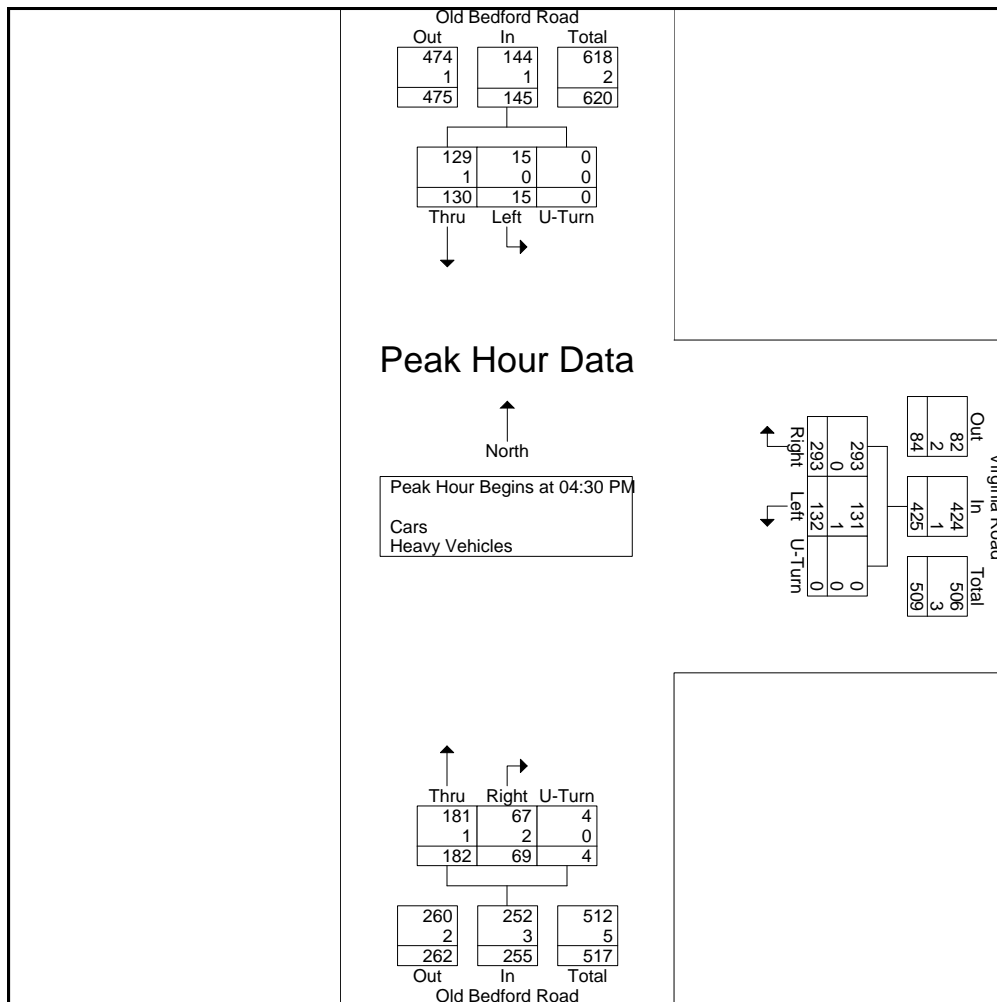
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E/W: Virginia Road
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 JJ
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

	Old Bedford Road From North				Virginia Road From East				Old Bedford Road From South				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:30 PM													
04:30 PM	24	5	0	29	80	26	0	106	12	45	0	57	192
04:45 PM	36	3	0	39	69	39	0	108	5	54	0	59	206
05:00 PM	34	3	0	37	60	37	0	97	10	63	0	73	207
05:15 PM	36	4	0	40	84	30	0	114	42	20	4	66	220
Total Volume	130	15	0	145	293	132	0	425	69	182	4	255	825
% App. Total	89.7	10.3	0		68.9	31.1	0		27.1	71.4	1.6		
PHF	.903	.750	.000	.906	.872	.846	.000	.932	.411	.722	.250	.873	.938
Cars	129	15	0	144	293	131	0	424	67	181	4	252	820
% Cars	99.2	100	0	99.3	100	99.2	0	99.8	97.1	99.5	100	98.8	99.4
Heavy Vehicles	1	0	0	1	0	1	0	1	2	1	0	3	5
% Heavy Vehicles	0.8	0	0	0.7	0	0.8	0	0.2	2.9	0.5	0	1.2	0.6





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S: Old Bedford Road
E/W: Bedford Street (Route 62)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 KK
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Bedford Street (Route 62) From East			Old Bedford Road From South			Bedford Street (Route 62) From West			
Start Time	Thru	Left	U-Turn	Right	Left	U-Turn	Right	Thru	U-Turn	Int. Total
03:00 PM	67	27	0	57	14	0	5	42	0	212
03:15 PM	69	20	0	53	10	0	6	49	1	208
03:30 PM	75	34	0	53	17	0	5	59	0	243
03:45 PM	67	37	0	66	17	0	6	67	0	260
Total	278	118	0	229	58	0	22	217	1	923
04:00 PM	70	35	0	77	27	0	4	51	0	264
04:15 PM	99	32	0	60	28	0	5	63	0	287
04:30 PM	93	25	0	71	52	0	4	65	0	310
04:45 PM	107	33	0	76	49	0	9	49	0	323
Total	369	125	0	284	156	0	22	228	0	1184
05:00 PM	114	34	0	76	46	0	5	45	0	320
05:15 PM	115	39	0	79	60	0	4	73	0	370
05:30 PM	120	33	0	63	50	0	1	60	0	327
05:45 PM	94	30	0	75	40	0	2	56	0	297
Total	443	136	0	293	196	0	12	234	0	1314
Grand Total	1090	379	0	806	410	0	56	679	1	3421
Apprch %	74.2	25.8	0	66.3	33.7	0	7.6	92.3	0.1	
Total %	31.9	11.1	0	23.6	12	0	1.6	19.8	0	
Cars	1076	375	0	800	409	0	55	667	1	3383
% Cars	98.7	98.9	0	99.3	99.8	0	98.2	98.2	100	98.9
Heavy Vehicles	14	4	0	6	1	0	1	12	0	38
% Heavy Vehicles	1.3	1.1	0	0.7	0.2	0	1.8	1.8	0	1.1

	Bedford Street (Route 62) From East				Old Bedford Road From South				Bedford Street (Route 62) From West				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:45 PM													
04:45 PM	107	33	0	140	76	49	0	125	9	49	0	58	323
05:00 PM	114	34	0	148	76	46	0	122	5	45	0	50	320
05:15 PM	115	39	0	154	79	60	0	139	4	73	0	77	370
05:30 PM	120	33	0	153	63	50	0	113	1	60	0	61	327
Total Volume	456	139	0	595	294	205	0	499	19	227	0	246	1340
% App. Total	76.6	23.4	0		58.9	41.1	0		7.7	92.3	0		
PHF	.950	.891	.000	.966	.930	.854	.000	.897	.528	.777	.000	.799	.905
Cars	453	139	0	592	294	204	0	498	19	222	0	241	1331
% Cars	99.3	100	0	99.5	100	99.5	0	99.8	100	97.8	0	98.0	99.3
Heavy Vehicles	3	0	0	3	0	1	0	1	0	5	0	5	9
% Heavy Vehicles	0.7	0	0	0.5	0	0.5	0	0.2	0	2.2	0	2.0	0.7



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S: Old Bedford Road
E/W: Bedford Street (Route 62)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 KK
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars

	Bedford Street (Route 62) From East			Old Bedford Road From South			Bedford Street (Route 62) From West			
Start Time	Thru	Left	U-Turn	Right	Left	U-Turn	Right	Thru	U-Turn	Int. Total
03:00 PM	64	27	0	57	14	0	4	42	0	208
03:15 PM	69	18	0	53	10	0	6	47	1	204
03:30 PM	73	34	0	52	17	0	5	59	0	240
03:45 PM	66	37	0	66	17	0	6	66	0	258
Total	272	116	0	228	58	0	21	214	1	910
04:00 PM	69	34	0	73	27	0	4	49	0	256
04:15 PM	96	32	0	59	28	0	5	61	0	281
04:30 PM	92	24	0	71	52	0	4	65	0	308
04:45 PM	106	33	0	76	49	0	9	49	0	322
Total	363	123	0	279	156	0	22	224	0	1167
05:00 PM	113	34	0	76	46	0	5	44	0	318
05:15 PM	114	39	0	79	59	0	4	73	0	368
05:30 PM	120	33	0	63	50	0	1	56	0	323
05:45 PM	94	30	0	75	40	0	2	56	0	297
Total	441	136	0	293	195	0	12	229	0	1306
Grand Total	1076	375	0	800	409	0	55	667	1	3383
Apprch %	74.2	25.8	0	66.2	33.8	0	7.6	92.3	0.1	
Total %	31.8	11.1	0	23.6	12.1	0	1.6	19.7	0	

	Bedford Street (Route 62) From East				Old Bedford Road From South				Bedford Street (Route 62) From West				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:45 PM													
04:45 PM	106	33	0	139	76	49	0	125	9	49	0	58	322
05:00 PM	113	34	0	147	76	46	0	122	5	44	0	49	318
05:15 PM	114	39	0	153	79	59	0	138	4	73	0	77	368
05:30 PM	120	33	0	153	63	50	0	113	1	56	0	57	323
Total Volume	453	139	0	592	294	204	0	498	19	222	0	241	1331
% App. Total	76.5	23.5	0		59	41	0		7.9	92.1	0		
PHF	.944	.891	.000	.967	.930	.864	.000	.902	.528	.760	.000	.782	.904



PRECISION
D A T A
INDUSTRIES, LLC

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Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

S: Old Bedford Road
E/W: Bedford Street (Route 62)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 KK
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

	Bedford Street (Route 62) From East			Old Bedford Road From South			Bedford Street (Route 62) From West			
Start Time	Thru	Left	U-Turn	Right	Left	U-Turn	Right	Thru	U-Turn	Int. Total
03:00 PM	3	0	0	0	0	0	1	0	0	4
03:15 PM	0	2	0	0	0	0	0	2	0	4
03:30 PM	2	0	0	1	0	0	0	0	0	3
03:45 PM	1	0	0	0	0	0	0	1	0	2
Total	6	2	0	1	0	0	1	3	0	13
04:00 PM	1	1	0	4	0	0	0	2	0	8
04:15 PM	3	0	0	1	0	0	0	2	0	6
04:30 PM	1	1	0	0	0	0	0	0	0	2
04:45 PM	1	0	0	0	0	0	0	0	0	1
Total	6	2	0	5	0	0	0	4	0	17
05:00 PM	1	0	0	0	0	0	0	1	0	2
05:15 PM	1	0	0	0	1	0	0	0	0	2
05:30 PM	0	0	0	0	0	0	0	4	0	4
05:45 PM	0	0	0	0	0	0	0	0	0	0
Total	2	0	0	0	1	0	0	5	0	8
Grand Total	14	4	0	6	1	0	1	12	0	38
Apprch %	77.8	22.2	0	85.7	14.3	0	7.7	92.3	0	
Total %	36.8	10.5	0	15.8	2.6	0	2.6	31.6	0	

	Bedford Street (Route 62) From East				Old Bedford Road From South				Bedford Street (Route 62) From West				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 03:30 PM													
03:30 PM	2	0	0	2	1	0	0	1	0	0	0	0	3
03:45 PM	1	0	0	1	0	0	0	0	0	1	0	1	2
04:00 PM	1	1	0	2	4	0	0	4	0	2	0	2	8
04:15 PM	3	0	0	3	1	0	0	1	0	2	0	2	6
Total Volume	7	1	0	8	6	0	0	6	0	5	0	5	19
% App. Total	87.5	12.5	0		100	0	0		0	100	0		
PHF	.583	.250	.000	.667	.375	.000	.000	.375	.000	.625	.000	.625	.594



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S: Old Bedford Road
E/W: Bedford Street (Route 62)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 KK
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

Start Time	Bedford Street (Route 62) From East			Old Bedford Road From South			Bedford Street (Route 62) From West			Int. Total
	Thru	Left	Peds	Right	Left	Peds	Right	Thru	Peds	
03:00 PM	0	1	0	0	0	0	0	0	0	1
03:15 PM	0	0	0	0	0	0	0	1	0	1
03:30 PM	0	0	0	0	0	0	0	0	0	0
03:45 PM	0	0	0	0	0	0	0	0	0	0
Total	0	1	0	0	0	0	0	1	0	2
04:00 PM	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	1	0	1
Total	0	0	0	0	0	0	0	1	0	1
Grand Total	0	1	0	0	0	0	0	2	0	3
Apprch %	0	100	0	0	0	0	0	100	0	
Total %	0	33.3	0	0	0	0	0	66.7	0	

	Bedford Street (Route 62) From East				Old Bedford Road From South				Bedford Street (Route 62) From West				
Start Time	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 03:00 PM													
03:00 PM	0	1	0	1	0	0	0	0	0	0	0	0	1
03:15 PM	0	0	0	0	0	0	0	0	0	1	0	1	1
03:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
03:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	0	1	0	1	0	0	0	0	0	1	0	1	2
% App. Total	0	100	0		0	0	0		0	100	0		
PHF	.000	.250	.000	.250	.000	.000	.000	.000	.000	.250	.000	.250	.500



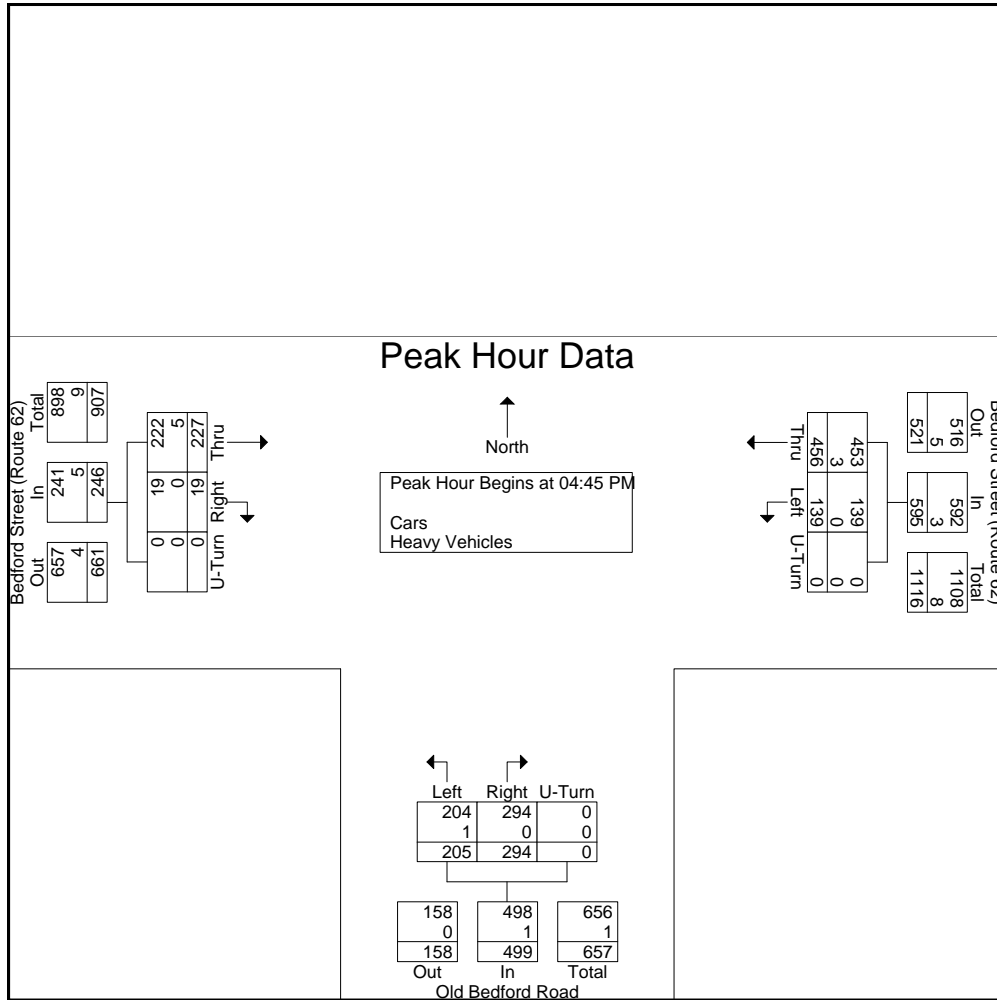
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INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
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S: Old Bedford Road
E/W: Bedford Street (Route 62)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 KK
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

	Bedford Street (Route 62) From East				Old Bedford Road From South				Bedford Street (Route 62) From West				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:45 PM													
04:45 PM	107	33	0	140	76	49	0	125	9	49	0	58	323
05:00 PM	114	34	0	148	76	46	0	122	5	45	0	50	320
05:15 PM	115	39	0	154	79	60	0	139	4	73	0	77	370
05:30 PM	120	33	0	153	63	50	0	113	1	60	0	61	327
Total Volume	456	139	0	595	294	205	0	499	19	227	0	246	1340
% App. Total	76.6	23.4	0		58.9	41.1	0		7.7	92.3	0		
PHF	.950	.891	.000	.966	.930	.854	.000	.897	.528	.777	.000	.799	.905
Cars	453	139	0	592	294	204	0	498	19	222	0	241	1331
% Cars	99.3	100	0	99.5	100	99.5	0	99.8	100	97.8	0	98.0	99.3
Heavy Vehicles	3	0	0	3	0	1	0	1	0	5	0	5	9
% Heavy Vehicles	0.7	0	0	0.5	0	0.5	0	0.2	0	2.2	0	2.0	0.7





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S: Hartwell Road
E/W: Concord Road (Route 62)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 LL
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Concord Road (Route 62) From East			Hartwell Road From South			Concord Road (Route 62) From West			
Start Time	Thru	Left	U-Turn	Right	Left	U-Turn	Right	Thru	U-Turn	Int. Total
03:00 PM	93	13	0	23	15	0	9	89	0	242
03:15 PM	100	3	0	11	19	0	22	138	0	293
03:30 PM	93	5	0	20	22	0	14	124	0	278
03:45 PM	83	4	0	13	25	0	10	119	0	254
Total	369	25	0	67	81	0	55	470	0	1067
04:00 PM	109	2	0	12	18	0	10	125	0	276
04:15 PM	114	9	0	15	32	0	15	114	0	299
04:30 PM	103	12	0	30	33	0	28	133	0	339
04:45 PM	111	8	0	11	41	0	17	101	0	289
Total	437	31	0	68	124	0	70	473	0	1203
05:00 PM	114	5	0	24	48	0	22	102	0	315
05:15 PM	142	5	0	11	38	0	15	137	0	348
05:30 PM	102	8	0	22	51	0	11	111	0	305
05:45 PM	113	9	0	17	35	0	17	101	0	292
Total	471	27	0	74	172	0	65	451	0	1260
Grand Total	1277	83	0	209	377	0	190	1394	0	3530
Apprch %	93.9	6.1	0	35.7	64.3	0	12	88	0	
Total %	36.2	2.4	0	5.9	10.7	0	5.4	39.5	0	
Cars	1252	82	0	206	374	0	187	1365	0	3466
% Cars	98	98.8	0	98.6	99.2	0	98.4	97.9	0	98.2
Heavy Vehicles	25	1	0	3	3	0	3	29	0	64
% Heavy Vehicles	2	1.2	0	1.4	0.8	0	1.6	2.1	0	1.8

	Concord Road (Route 62) From East				Hartwell Road From South				Concord Road (Route 62) From West				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:30 PM													
04:30 PM	103	12	0	115	30	33	0	63	28	133	0	161	339
04:45 PM	111	8	0	119	11	41	0	52	17	101	0	118	289
05:00 PM	114	5	0	119	24	48	0	72	22	102	0	124	315
05:15 PM	142	5	0	147	11	38	0	49	15	137	0	152	348
Total Volume	470	30	0	500	76	160	0	236	82	473	0	555	1291
% App. Total	94	6	0		32.2	67.8	0		14.8	85.2	0		
PHF	.827	.625	.000	.850	.633	.833	.000	.819	.732	.863	.000	.862	.927
Cars	465	30	0	495	75	160	0	235	82	470	0	552	1282
% Cars	98.9	100	0	99.0	98.7	100	0	99.6	100	99.4	0	99.5	99.3
Heavy Vehicles	5	0	0	5	1	0	0	1	0	3	0	3	9
% Heavy Vehicles	1.1	0	0	1.0	1.3	0	0	0.4	0	0.6	0	0.5	0.7

S: Hartwell Road
 E/W: Concord Road (Route 62)
 City, State: Bedford, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 LL
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

Groups Printed- Cars										
	Concord Road (Route 62) From East			Hartwell Road From South			Concord Road (Route 62) From West			
Start Time	Thru	Left	U-Turn	Right	Left	U-Turn	Right	Thru	U-Turn	Int. Total
03:00 PM	91	13	0	21	14	0	9	88	0	236
03:15 PM	89	3	0	11	17	0	22	136	0	278
03:30 PM	91	5	0	20	22	0	13	111	0	262
03:45 PM	82	4	0	13	25	0	10	117	0	251
Total	353	25	0	65	78	0	54	452	0	1027
04:00 PM	108	2	0	12	18	0	10	122	0	272
04:15 PM	111	8	0	15	32	0	14	112	0	292
04:30 PM	101	12	0	30	33	0	28	132	0	336
04:45 PM	110	8	0	10	41	0	17	101	0	287
Total	430	30	0	67	124	0	69	467	0	1187
05:00 PM	113	5	0	24	48	0	22	102	0	314
05:15 PM	141	5	0	11	38	0	15	135	0	345
05:30 PM	102	8	0	22	51	0	10	109	0	302
05:45 PM	113	9	0	17	35	0	17	100	0	291
Total	469	27	0	74	172	0	64	446	0	1252
Grand Total	1252	82	0	206	374	0	187	1365	0	3466
Apprch %	93.9	6.1	0	35.5	64.5	0	12	88	0	
Total %	36.1	2.4	0	5.9	10.8	0	5.4	39.4	0	

	Concord Road (Route 62) From East				Hartwell Road From South				Concord Road (Route 62) From West				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:30 PM													
04:30 PM	101	12	0	113	30	33	0	63	28	132	0	160	336
04:45 PM	110	8	0	118	10	41	0	51	17	101	0	118	287
05:00 PM	113	5	0	118	24	48	0	72	22	102	0	124	314
05:15 PM	141	5	0	146	11	38	0	49	15	135	0	150	345
Total Volume	465	30	0	495	75	160	0	235	82	470	0	552	1282
% App. Total	93.9	6.1	0		31.9	68.1	0		14.9	85.1	0		
PHF	.824	.625	.000	.848	.625	.833	.000	.816	.732	.870	.000	.863	.929



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S: Hartwell Road
E/W: Concord Road (Route 62)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 LL
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

	Concord Road (Route 62) From East			Hartwell Road From South			Concord Road (Route 62) From West			
Start Time	Thru	Left	U-Turn	Right	Left	U-Turn	Right	Thru	U-Turn	Int. Total
03:00 PM	2	0	0	2	1	0	0	1	0	6
03:15 PM	11	0	0	0	2	0	0	2	0	15
03:30 PM	2	0	0	0	0	0	1	13	0	16
03:45 PM	1	0	0	0	0	0	0	2	0	3
Total	16	0	0	2	3	0	1	18	0	40
04:00 PM	1	0	0	0	0	0	0	3	0	4
04:15 PM	3	1	0	0	0	0	1	2	0	7
04:30 PM	2	0	0	0	0	0	0	1	0	3
04:45 PM	1	0	0	1	0	0	0	0	0	2
Total	7	1	0	1	0	0	1	6	0	16
05:00 PM	1	0	0	0	0	0	0	0	0	1
05:15 PM	1	0	0	0	0	0	0	2	0	3
05:30 PM	0	0	0	0	0	0	1	2	0	3
05:45 PM	0	0	0	0	0	0	0	1	0	1
Total	2	0	0	0	0	0	1	5	0	8
Grand Total	25	1	0	3	3	0	3	29	0	64
Apprch %	96.2	3.8	0	50	50	0	9.4	90.6	0	
Total %	39.1	1.6	0	4.7	4.7	0	4.7	45.3	0	

	Concord Road (Route 62) From East				Hartwell Road From South				Concord Road (Route 62) From West				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 03:00 PM													
03:00 PM	2	0	0	2	2	1	0	3	0	1	0	1	6
03:15 PM	11	0	0	11	0	2	0	2	0	2	0	2	15
03:30 PM	2	0	0	2	0	0	0	0	1	13	0	14	16
03:45 PM	1	0	0	1	0	0	0	0	0	2	0	2	3
Total Volume	16	0	0	16	2	3	0	5	1	18	0	19	40
% App. Total	100	0	0		40	60	0		5.3	94.7	0		
PHF	.364	.000	.000	.364	.250	.375	.000	.417	.250	.346	.000	.339	.625



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S: Hartwell Road
E/W: Concord Road (Route 62)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 LL
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

	Concord Road (Route 62) From East			Hartwell Road From South			Concord Road (Route 62) From West			
Start Time	Thru	Left	Peds	Right	Left	Peds	Right	Thru	Peds	Int. Total
03:00 PM	1	0	0	0	0	1	0	0	0	2
03:15 PM	0	0	0	0	0	0	0	0	0	0
03:30 PM	0	0	0	0	0	0	0	1	0	1
03:45 PM	0	0	0	0	0	0	0	0	0	0
Total	1	0	0	0	0	1	0	1	0	3
04:00 PM	0	0	0	0	0	0	0	0	0	0
04:15 PM	1	0	0	0	0	0	0	1	0	2
04:30 PM	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0
Total	1	0	0	0	0	0	0	1	0	2
05:00 PM	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	1	0	1
Total	0	0	0	0	0	0	0	1	0	1
Grand Total	2	0	0	0	0	1	0	3	0	6
Apprch %	100	0	0	0	0	100	0	100	0	
Total %	33.3	0	0	0	0	16.7	0	50	0	

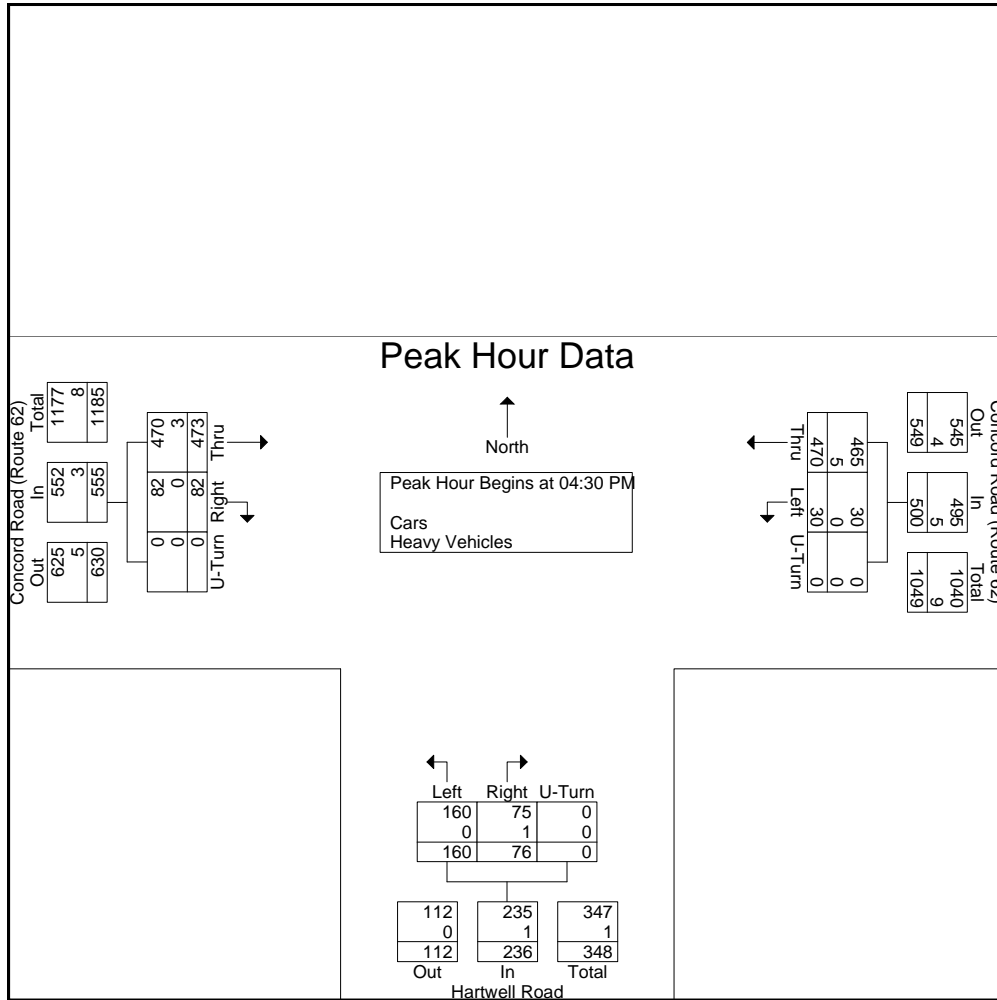
	Concord Road (Route 62) From East				Hartwell Road From South				Concord Road (Route 62) From West				
Start Time	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 03:00 PM													
03:00 PM	1	0	0	1	0	0	1	1	0	0	0	0	2
03:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
03:30 PM	0	0	0	0	0	0	0	0	0	1	0	1	1
03:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Volume	1	0	0	1	0	0	1	1	0	1	0	1	3
% App. Total	100	0	0		0	0	100		0	100	0		
PHF	.250	.000	.000	.250	.000	.000	.250	.250	.000	.250	.000	.250	.375

S: Hartwell Road
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 City, State: Bedford, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 LL
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

	Concord Road (Route 62) From East				Hartwell Road From South				Concord Road (Route 62) From West				
Start Time	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:30 PM													
04:30 PM	103	12	0	115	30	33	0	63	28	133	0	161	339
04:45 PM	111	8	0	119	11	41	0	52	17	101	0	118	289
05:00 PM	114	5	0	119	24	48	0	72	22	102	0	124	315
05:15 PM	142	5	0	147	11	38	0	49	15	137	0	152	348
Total Volume	470	30	0	500	76	160	0	236	82	473	0	555	1291
% App. Total	94	6	0		32.2	67.8	0		14.8	85.2	0		
PHF	.827	.625	.000	.850	.633	.833	.000	.819	.732	.863	.000	.862	.927
Cars	465	30	0	495	75	160	0	235	82	470	0	552	1282
% Cars	98.9	100	0	99.0	98.7	100	0	99.6	100	99.4	0	99.5	99.3
Heavy Vehicles	5	0	0	5	1	0	0	1	0	3	0	3	9
% Heavy Vehicles	1.1	0	0	1.0	1.3	0	0	0.4	0	0.6	0	0.5	0.7





PRECISION
D A T A
INDUSTRIES, LLC

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N/S: South Road
W: Hartwell Road
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 MM
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	South Road From North			South Road From South			Hartwell Road From West			
Start Time	Right	Thru	U-Turn	Thru	Left	U-Turn	Right	Left	U-Turn	Int. Total
03:00 PM	10	31	0	80	15	0	10	13	0	159
03:15 PM	18	25	0	79	14	0	15	13	0	164
03:30 PM	14	50	0	116	13	0	13	31	0	237
03:45 PM	21	28	0	151	17	0	8	20	0	245
Total	63	134	0	426	59	0	46	77	0	805
04:00 PM	18	35	0	146	16	0	16	15	0	246
04:15 PM	16	33	0	189	17	0	11	19	0	285
04:30 PM	17	30	0	181	29	0	16	29	0	302
04:45 PM	24	37	0	189	23	0	13	39	0	325
Total	75	135	0	705	85	0	56	102	0	1158
05:00 PM	11	41	0	237	28	0	16	34	0	367
05:15 PM	18	29	0	210	33	0	17	22	0	329
05:30 PM	11	33	0	220	35	0	13	19	0	331
05:45 PM	25	23	0	204	38	0	7	14	0	311
Total	65	126	0	871	134	0	53	89	0	1338
Grand Total	203	395	0	2002	278	0	155	268	0	3301
Apprch %	33.9	66.1	0	87.8	12.2	0	36.6	63.4	0	
Total %	6.1	12	0	60.6	8.4	0	4.7	8.1	0	
Cars	200	386	0	1975	273	0	150	263	0	3247
% Cars	98.5	97.7	0	98.7	98.2	0	96.8	98.1	0	98.4
Heavy Vehicles	3	9	0	27	5	0	5	5	0	54
% Heavy Vehicles	1.5	2.3	0	1.3	1.8	0	3.2	1.9	0	1.6

	South Road From North				South Road From South				Hartwell Road From West				
Start Time	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:45 PM													
04:45 PM	24	37	0	61	189	23	0	212	13	39	0	52	325
05:00 PM	11	41	0	52	237	28	0	265	16	34	0	50	367
05:15 PM	18	29	0	47	210	33	0	243	17	22	0	39	329
05:30 PM	11	33	0	44	220	35	0	255	13	19	0	32	331
Total Volume	64	140	0	204	856	119	0	975	59	114	0	173	1352
% App. Total	31.4	68.6	0		87.8	12.2	0		34.1	65.9	0		
PHF	.667	.854	.000	.836	.903	.850	.000	.920	.868	.731	.000	.832	.921
Cars	64	139	0	203	846	119	0	965	59	111	0	170	1338
% Cars	100	99.3	0	99.5	98.8	100	0	99.0	100	97.4	0	98.3	99.0
Heavy Vehicles	0	1	0	1	10	0	0	10	0	3	0	3	14
% Heavy Vehicles	0	0.7	0	0.5	1.2	0	0	1.0	0	2.6	0	1.7	1.0



PRECISION
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N/S: South Road
W: Hartwell Road
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 MM
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars

Start Time	South Road From North			South Road From South			Hartwell Road From West			Int. Total
	Right	Thru	U-Turn	Thru	Left	U-Turn	Right	Left	U-Turn	
03:00 PM	9	29	0	77	15	0	9	12	0	151
03:15 PM	18	24	0	78	12	0	13	13	0	158
03:30 PM	14	49	0	109	13	0	12	31	0	228
03:45 PM	21	27	0	149	16	0	8	20	0	241
Total	62	129	0	413	56	0	42	76	0	778
04:00 PM	16	34	0	144	16	0	16	15	0	241
04:15 PM	16	32	0	188	16	0	11	18	0	281
04:30 PM	17	29	0	180	28	0	16	29	0	299
04:45 PM	24	37	0	185	23	0	13	38	0	320
Total	73	132	0	697	83	0	56	100	0	1141
05:00 PM	11	41	0	235	28	0	16	32	0	363
05:15 PM	18	28	0	207	33	0	17	22	0	325
05:30 PM	11	33	0	219	35	0	13	19	0	330
05:45 PM	25	23	0	204	38	0	6	14	0	310
Total	65	125	0	865	134	0	52	87	0	1328
Grand Total	200	386	0	1975	273	0	150	263	0	3247
Apprch %	34.1	65.9	0	87.9	12.1	0	36.3	63.7	0	
Total %	6.2	11.9	0	60.8	8.4	0	4.6	8.1	0	

	South Road From North				South Road From South				Hartwell Road From West				
Start Time	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:45 PM													
04:45 PM	24	37	0	61	185	23	0	208	13	38	0	51	320
05:00 PM	11	41	0	52	235	28	0	263	16	32	0	48	363
05:15 PM	18	28	0	46	207	33	0	240	17	22	0	39	325
05:30 PM	11	33	0	44	219	35	0	254	13	19	0	32	330
Total Volume	64	139	0	203	846	119	0	965	59	111	0	170	1338
% App. Total	31.5	68.5	0		87.7	12.3	0		34.7	65.3	0		
PHF	.667	.848	.000	.832	.900	.850	.000	.917	.868	.730	.000	.833	.921



PRECISION
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N/S: South Road
W: Hartwell Road
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 MM
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

Start Time	South Road From North			South Road From South			Hartwell Road From West			Int. Total
	Right	Thru	U-Turn	Thru	Left	U-Turn	Right	Left	U-Turn	
03:00 PM	1	2	0	3	0	0	1	1	0	8
03:15 PM	0	1	0	1	2	0	2	0	0	6
03:30 PM	0	1	0	7	0	0	1	0	0	9
03:45 PM	0	1	0	2	1	0	0	0	0	4
Total	1	5	0	13	3	0	4	1	0	27
04:00 PM	2	1	0	2	0	0	0	0	0	5
04:15 PM	0	1	0	1	1	0	0	1	0	4
04:30 PM	0	1	0	1	1	0	0	0	0	3
04:45 PM	0	0	0	4	0	0	0	1	0	5
Total	2	3	0	8	2	0	0	2	0	17
05:00 PM	0	0	0	2	0	0	0	2	0	4
05:15 PM	0	1	0	3	0	0	0	0	0	4
05:30 PM	0	0	0	1	0	0	0	0	0	1
05:45 PM	0	0	0	0	0	0	1	0	0	1
Total	0	1	0	6	0	0	1	2	0	10
Grand Total	3	9	0	27	5	0	5	5	0	54
Apprch %	25	75	0	84.4	15.6	0	50	50	0	
Total %	5.6	16.7	0	50	9.3	0	9.3	9.3	0	

	South Road From North				South Road From South				Hartwell Road From West				
Start Time	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 03:00 PM													
03:00 PM	1	2	0	3	3	0	0	3	1	1	0	2	8
03:15 PM	0	1	0	1	1	2	0	3	2	0	0	2	6
03:30 PM	0	1	0	1	7	0	0	7	1	0	0	1	9
03:45 PM	0	1	0	1	2	1	0	3	0	0	0	0	4
Total Volume	1	5	0	6	13	3	0	16	4	1	0	5	27
% App. Total	16.7	83.3	0		81.2	18.8	0		80	20	0		
PHF	.250	.625	.000	.500	.464	.375	.000	.571	.500	.250	.000	.625	.750



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W: Hartwell Road
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 MM
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

Start Time	South Road From North			South Road From South			Hartwell Road From West			Int. Total
	Right	Thru	Peds	Thru	Left	Peds	Right	Left	Peds	
03:00 PM	0	0	0	0	0	0	0	0	0	0
03:15 PM	0	0	0	0	0	0	0	0	0	0
03:30 PM	0	0	0	0	0	0	0	0	1	1
03:45 PM	0	0	0	0	0	0	0	0	1	1
Total	0	0	0	0	0	0	0	0	2	2
04:00 PM	0	0	0	0	1	0	0	0	0	1
04:15 PM	1	0	0	0	0	0	0	0	0	1
04:30 PM	0	0	0	0	0	0	0	1	0	1
04:45 PM	0	0	0	0	0	0	0	0	0	0
Total	1	0	0	0	1	0	0	1	0	3
05:00 PM	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0
Grand Total	1	0	0	0	1	0	0	1	2	5
Apprch %	100	0	0	0	100	0	0	33.3	66.7	
Total %	20	0	0	0	20	0	0	20	40	

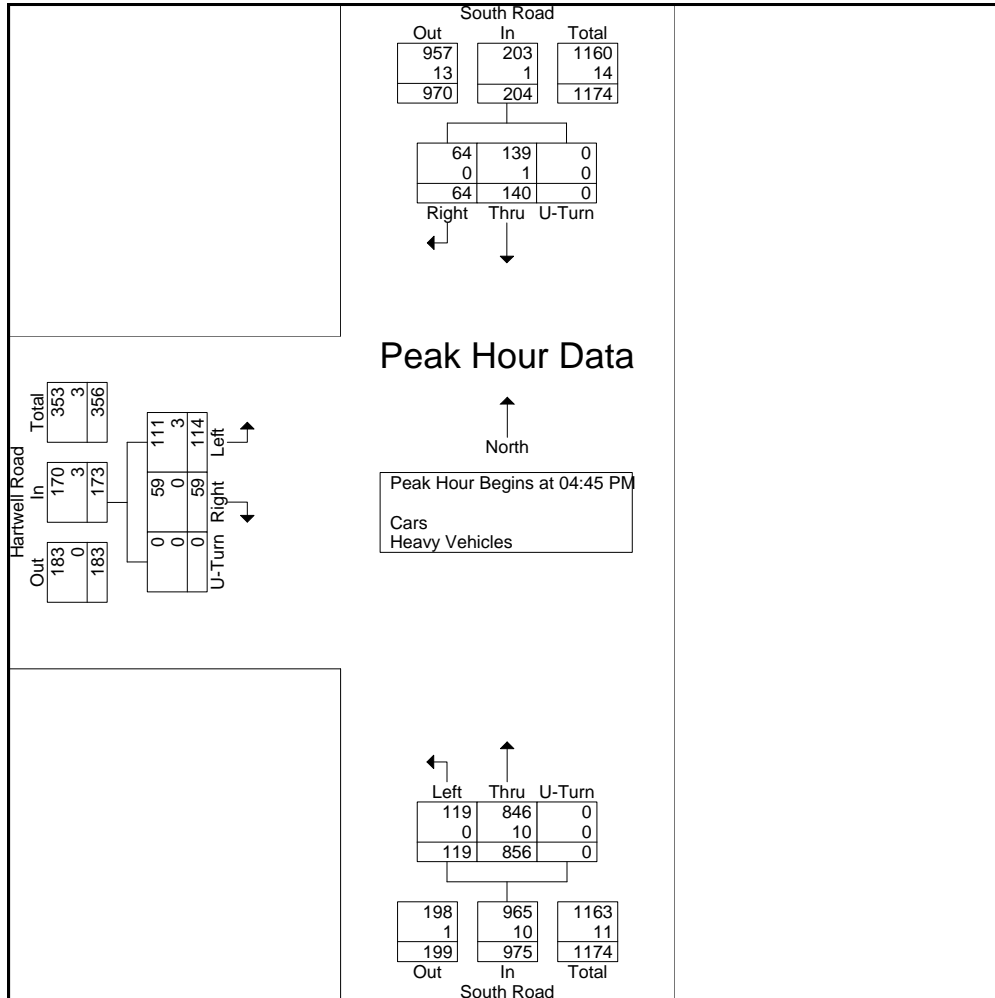
	South Road From North				South Road From South				Hartwell Road From West				
Start Time	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 03:30 PM													
03:30 PM	0	0	0	0	0	0	0	0	0	0	1	1	1
03:45 PM	0	0	0	0	0	0	0	0	0	0	1	1	1
04:00 PM	0	0	0	0	0	1	0	1	0	0	0	0	1
04:15 PM	1	0	0	1	0	0	0	0	0	0	0	0	1
Total Volume	1	0	0	1	0	1	0	1	0	0	2	2	4
% App. Total	100	0	0		0	100	0		0	0	100		
PHF	.250	.000	.000	.250	.000	.250	.000	.250	.000	.000	.500	.500	1.00

N/S: South Road
W: Hartwell Road
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink



File Name : 123082 MM
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

	South Road From North				South Road From South				Hartwell Road From West				
Start Time	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:45 PM													
04:45 PM	24	37	0	61	189	23	0	212	13	39	0	52	325
05:00 PM	11	41	0	52	237	28	0	265	16	34	0	50	367
05:15 PM	18	29	0	47	210	33	0	243	17	22	0	39	329
05:30 PM	11	33	0	44	220	35	0	255	13	19	0	32	331
Total Volume	64	140	0	204	856	119	0	975	59	114	0	173	1352
% App. Total	31.4	68.6	0		87.8	12.2	0		34.1	65.9	0		
PHF	.667	.854	.000	.836	.903	.850	.000	.920	.868	.731	.000	.832	.921
Cars	64	139	0	203	846	119	0	965	59	111	0	170	1338
% Cars	100	99.3	0	99.5	98.8	100	0	99.0	100	97.4	0	98.3	99.0
Heavy Vehicles	0	1	0	1	10	0	0	10	0	3	0	3	14
% Heavy Vehicles	0	0.7	0	0.5	1.2	0	0	1.0	0	2.6	0	1.7	1.0



N: North Road (Route 4/225)
 E/W: Great Rd (4/225)/ Concord Rd (62)
 City, State: Bedford, MA
 Client: Toole Engineering/ C. Fink



File Name : 123082 NN
 Site Code : TBA
 Start Date : 11/13/2012
 Page No : 1

Groups Printed- Cars - Heavy Vehicles

	North Road (Route 4/225) From North			Great Road (Route 4/225) From East			Concord Road (Route 62) From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
03:00 PM	49	95	0	160	73	0	55	68	0	500
03:15 PM	37	70	0	166	82	0	88	67	0	510
03:30 PM	35	85	0	166	78	0	72	69	0	505
03:45 PM	34	89	0	203	61	0	73	64	0	524
Total	155	339	0	695	294	0	288	268	0	2039
04:00 PM	34	80	0	234	84	0	46	73	0	551
04:15 PM	41	85	0	242	89	0	42	74	0	573
04:30 PM	44	67	0	246	69	0	44	66	0	536
04:45 PM	34	69	0	246	89	0	26	79	0	543
Total	153	301	0	968	331	0	158	292	0	2203
05:00 PM	52	78	0	252	79	0	27	72	0	560
05:15 PM	47	86	0	255	74	0	28	78	0	568
05:30 PM	44	105	0	249	67	0	22	64	0	551
05:45 PM	54	75	0	266	69	0	26	65	0	555
Total	197	344	0	1022	289	0	103	279	0	2234
Grand Total	505	984	0	2685	914	0	549	839	0	6476
Apprch %	33.9	66.1	0	74.6	25.4	0	39.6	60.4	0	
Total %	7.8	15.2	0	41.5	14.1	0	8.5	13	0	
Cars	494	960	0	2652	899	0	534	827	0	6366
% Cars	97.8	97.6	0	98.8	98.4	0	97.3	98.6	0	98.3
Heavy Vehicles	11	24	0	33	15	0	15	12	0	110
% Heavy Vehicles	2.2	2.4	0	1.2	1.6	0	2.7	1.4	0	1.7

	North Road (Route 4/225) From North				Great Road (Route 4/225) From East				Concord Road (Route 62) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 05:00 PM													
05:00 PM	52	78	0	130	252	79	0	331	27	72	0	99	560
05:15 PM	47	86	0	133	255	74	0	329	28	78	0	106	568
05:30 PM	44	105	0	149	249	67	0	316	22	64	0	86	551
05:45 PM	54	75	0	129	266	69	0	335	26	65	0	91	555
Total Volume	197	344	0	541	1022	289	0	1311	103	279	0	382	2234
% App. Total	36.4	63.6	0		78	22	0		27	73	0		
PHF	.912	.819	.000	.908	.961	.915	.000	.978	.920	.894	.000	.901	.983
Cars	197	337	0	534	1017	288	0	1305	100	277	0	377	2216
% Cars	100	98.0	0	98.7	99.5	99.7	0	99.5	97.1	99.3	0	98.7	99.2
Heavy Vehicles	0	7	0	7	5	1	0	6	3	2	0	5	18
% Heavy Vehicles	0	2.0	0	1.3	0.5	0.3	0	0.5	2.9	0.7	0	1.3	0.8



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E/W: Great Rd (4/225)/ Concord Rd (62)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 NN
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars

	North Road (Route 4/225) From North			Great Road (Route 4/225) From East			Concord Road (Route 62) From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
03:00 PM	44	86	0	156	70	0	54	65	0	475
03:15 PM	36	69	0	162	77	0	86	67	0	497
03:30 PM	34	83	0	162	78	0	68	64	0	489
03:45 PM	34	88	0	196	60	0	73	64	0	515
Total	148	326	0	676	285	0	281	260	0	1976
04:00 PM	32	77	0	229	83	0	45	71	0	537
04:15 PM	40	85	0	239	87	0	41	74	0	566
04:30 PM	43	66	0	246	69	0	42	66	0	532
04:45 PM	34	69	0	245	87	0	25	79	0	539
Total	149	297	0	959	326	0	153	290	0	2174
05:00 PM	52	75	0	250	79	0	27	72	0	555
05:15 PM	47	84	0	253	73	0	26	78	0	561
05:30 PM	44	104	0	249	67	0	22	63	0	549
05:45 PM	54	74	0	265	69	0	25	64	0	551
Total	197	337	0	1017	288	0	100	277	0	2216
Grand Total	494	960	0	2652	899	0	534	827	0	6366
Apprch %	34	66	0	74.7	25.3	0	39.2	60.8	0	
Total %	7.8	15.1	0	41.7	14.1	0	8.4	13	0	

	North Road (Route 4/225) From North				Great Road (Route 4/225) From East				Concord Road (Route 62) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 05:00 PM													
05:00 PM	52	75	0	127	250	79	0	329	27	72	0	99	555
05:15 PM	47	84	0	131	253	73	0	326	26	78	0	104	561
05:30 PM	44	104	0	148	249	67	0	316	22	63	0	85	549
05:45 PM	54	74	0	128	265	69	0	334	25	64	0	89	551
Total Volume	197	337	0	534	1017	288	0	1305	100	277	0	377	2216
% App. Total	36.9	63.1	0		77.9	22.1	0		26.5	73.5	0		
PHF	.912	.810	.000	.902	.959	.911	.000	.977	.926	.888	.000	.906	.988



PRECISION
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E/W: Great Rd (4/225)/ Concord Rd (62)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 NN
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

	North Road (Route 4/225) From North			Great Road (Route 4/225) From East			Concord Road (Route 62) From West			
Start Time	Right	Left	U-Turn	Right	Thru	U-Turn	Thru	Left	U-Turn	Int. Total
03:00 PM	5	9	0	4	3	0	1	3	0	25
03:15 PM	1	1	0	4	5	0	2	0	0	13
03:30 PM	1	2	0	4	0	0	4	5	0	16
03:45 PM	0	1	0	7	1	0	0	0	0	9
Total	7	13	0	19	9	0	7	8	0	63
04:00 PM	2	3	0	5	1	0	1	2	0	14
04:15 PM	1	0	0	3	2	0	1	0	0	7
04:30 PM	1	1	0	0	0	0	2	0	0	4
04:45 PM	0	0	0	1	2	0	1	0	0	4
Total	4	4	0	9	5	0	5	2	0	29
05:00 PM	0	3	0	2	0	0	0	0	0	5
05:15 PM	0	2	0	2	1	0	2	0	0	7
05:30 PM	0	1	0	0	0	0	0	1	0	2
05:45 PM	0	1	0	1	0	0	1	1	0	4
Total	0	7	0	5	1	0	3	2	0	18
Grand Total	11	24	0	33	15	0	15	12	0	110
Apprch %	31.4	68.6	0	68.8	31.2	0	55.6	44.4	0	
Total %	10	21.8	0	30	13.6	0	13.6	10.9	0	

	North Road (Route 4/225) From North				Great Road (Route 4/225) From East				Concord Road (Route 62) From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 03:00 PM													
03:00 PM	5	9	0	14	4	3	0	7	1	3	0	4	25
03:15 PM	1	1	0	2	4	5	0	9	2	0	0	2	13
03:30 PM	1	2	0	3	4	0	0	4	4	5	0	9	16
03:45 PM	0	1	0	1	7	1	0	8	0	0	0	0	9
Total Volume	7	13	0	20	19	9	0	28	7	8	0	15	63
% App. Total	35	65	0		67.9	32.1	0		46.7	53.3	0		
PHF	.350	.361	.000	.357	.679	.450	.000	.778	.438	.400	.000	.417	.630



PRECISION
D A T A
INDUSTRIES, LLC

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N: North Road (Route 4/225)
E/W: Great Rd (4/225)/ Concord Rd (62)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 NN
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

	North Road (Route 4/225) From North			Great Road (Route 4/225) From East			Concord Road (Route 62) From West			
Start Time	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	Int. Total
03:00 PM	0	0	0	0	1	0	0	0	0	1
03:15 PM	0	0	0	0	0	0	0	0	0	0
03:30 PM	0	0	0	0	0	0	0	0	0	0
03:45 PM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	1	0	0	0	0	1
04:00 PM	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	1	1	0	0	1	0	3
04:30 PM	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	1	1	0	0	1	0	3
05:00 PM	0	0	0	1	0	0	0	0	0	1
05:15 PM	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	1	0	0	0	0	0	0	1
05:45 PM	0	0	0	0	0	0	0	0	0	0
Total	0	0	1	1	0	0	0	0	0	2
Grand Total	0	0	1	2	2	0	0	1	0	6
Apprch %	0	0	100	50	50	0	0	100	0	
Total %	0	0	16.7	33.3	33.3	0	0	16.7	0	

	North Road (Route 4/225) From North				Great Road (Route 4/225) From East				Concord Road (Route 62) From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:15 PM													
04:15 PM	0	0	0	0	1	1	0	2	0	1	0	1	3
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	0	0	0	1	0	0	1	0	0	0	0	1
Total Volume	0	0	0	0	2	1	0	3	0	1	0	1	4
% App. Total	0	0	0		66.7	33.3	0		0	100	0		
PHF	.000	.000	.000	.000	.500	.250	.000	.375	.000	.250	.000	.250	.333



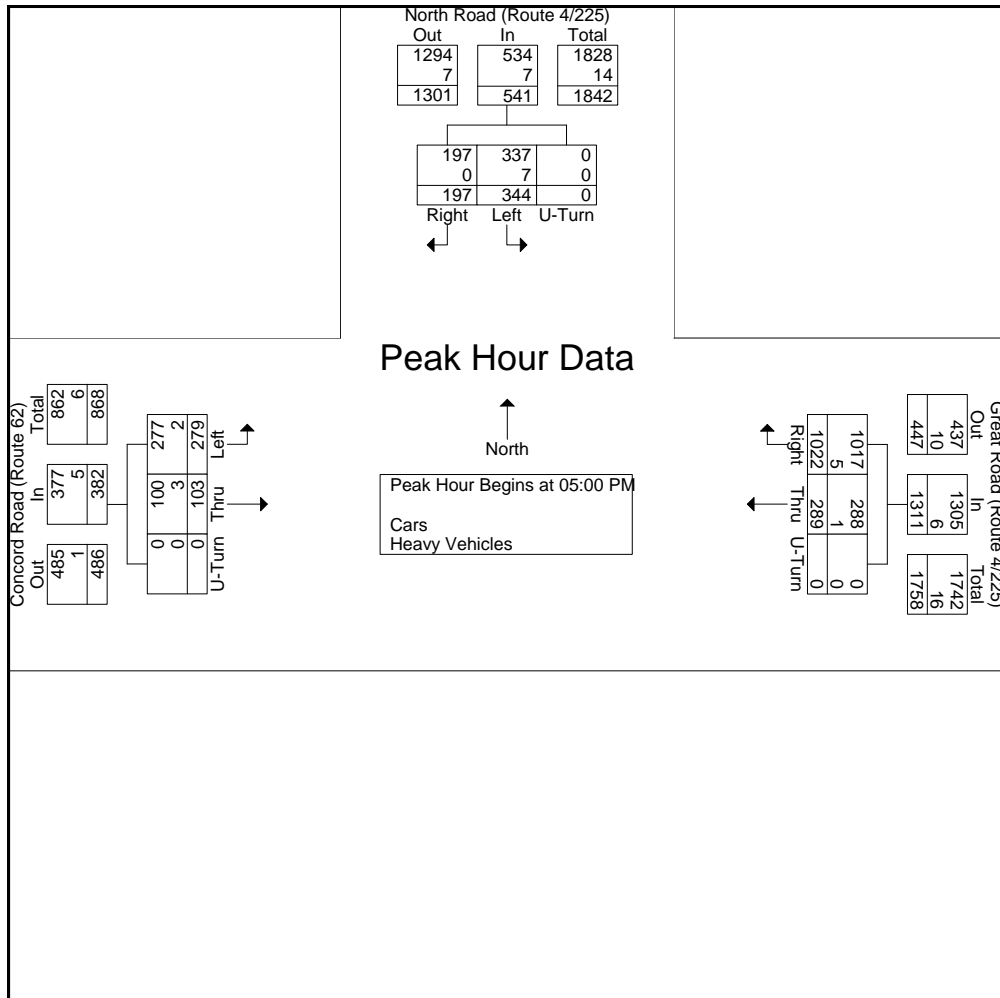
PRECISION
D A T A
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N: North Road (Route 4/225)
E/W: Great Rd (4/225)/ Concord Rd (62)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 NN
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

	North Road (Route 4/225)				Great Road (Route 4/225)				Concord Road (Route 62)				
	From North				From East				From West				
Start Time	Right	Left	U-Turn	App. Total	Right	Thru	U-Turn	App. Total	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 05:00 PM													
05:00 PM	52	78	0	130	252	79	0	331	27	72	0	99	560
05:15 PM	47	86	0	133	255	74	0	329	28	78	0	106	568
05:30 PM	44	105	0	149	249	67	0	316	22	64	0	86	551
05:45 PM	54	75	0	129	266	69	0	335	26	65	0	91	555
Total Volume	197	344	0	541	1022	289	0	1311	103	279	0	382	2234
% App. Total	36.4	63.6	0		78	22	0		27	73	0		
PHF	.912	.819	.000	.908	.961	.915	.000	.978	.920	.894	.000	.901	.983
Cars	197	337	0	534	1017	288	0	1305	100	277	0	377	2216
% Cars	100	98.0	0	98.7	99.5	99.7	0	99.5	97.1	99.3	0	98.7	99.2
Heavy Vehicles	0	7	0	7	5	1	0	6	3	2	0	5	18
% Heavy Vehicles	0	2.0	0	1.3	0.5	0.3	0	0.5	2.9	0.7	0	1.3	0.8





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N/S: Springs Road/ South Road
E/W: Great Road (Route 4/62/225)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 OO
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Springs Road From North				Great Road (Route 4/62/225) From East				South Road From South				Great Road (Route 4/62/225) From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
03:00 PM	36	11	15	0	0	145	1	0	14	16	61	0	9	156	4	0	468
03:15 PM	32	6	18	0	4	162	3	0	10	17	55	0	10	139	9	0	465
03:30 PM	35	4	17	0	1	160	0	0	12	27	74	0	8	149	11	0	498
03:45 PM	31	5	16	0	3	155	3	0	14	45	94	0	11	133	9	0	519
Total	134	26	66	0	8	622	7	0	50	105	284	0	38	577	33	0	1950
04:00 PM	55	8	28	0	3	160	0	0	17	44	95	0	3	117	8	0	538
04:15 PM	60	4	20	0	1	173	1	0	9	61	96	0	7	126	5	0	563
04:30 PM	55	2	20	0	3	171	2	0	9	48	93	0	4	101	9	0	517
04:45 PM	64	11	17	0	0	177	0	0	5	52	85	0	9	94	6	0	520
Total	234	25	85	0	7	681	3	0	40	205	369	0	23	438	28	0	2138
05:00 PM	49	8	10	0	3	185	0	0	10	37	89	0	15	100	7	0	513
05:15 PM	57	3	10	0	2	173	0	0	3	47	89	0	8	115	8	0	515
05:30 PM	67	7	9	0	3	174	0	0	2	33	87	0	8	125	8	0	523
05:45 PM	48	6	11	0	2	175	2	0	4	44	103	0	8	96	6	0	505
Total	221	24	40	0	10	707	2	0	19	161	368	0	39	436	29	0	2056
Grand Total	589	75	191	0	25	2010	12	0	109	471	1021	0	100	1451	90	0	6144
Apprch %	68.9	8.8	22.3	0	1.2	98.2	0.6	0	6.8	29.4	63.8	0	6.1	88.4	5.5	0	
Total %	9.6	1.2	3.1	0	0.4	32.7	0.2	0	1.8	7.7	16.6	0	1.6	23.6	1.5	0	
Cars	586	72	187	0	24	1981	12	0	109	467	1013	0	99	1415	89	0	6054
% Cars	99.5	96	97.9	0	96	98.6	100	0	100	99.2	99.2	0	99	97.5	98.9	0	98.5
Heavy Vehicles	3	3	4	0	1	29	0	0	0	4	8	0	1	36	1	0	90
% Heavy Vehicles	0.5	4	2.1	0	4	1.4	0	0	0	0.8	0.8	0	1	2.5	1.1	0	1.5

	Springs Road From North					Great Road (Route 4/62/225) From East					South Road From South					Great Road (Route 4/62/225) From West					Int. Total
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:00 PM																					
04:00 PM	55	8	28	0	91	3	160	0	0	163	17	44	95	0	156	3	117	8	0	128	538
04:15 PM	60	4	20	0	84	1	173	1	0	175	9	61	96	0	166	7	126	5	0	138	563
04:30 PM	55	2	20	0	77	3	171	2	0	176	9	48	93	0	150	4	101	9	0	114	517
04:45 PM	64	11	17	0	92	0	177	0	0	177	5	52	85	0	142	9	94	6	0	109	520
Total Volume	234	25	85	0	344	7	681	3	0	691	40	205	369	0	614	23	438	28	0	489	2138
% App. Total	68	7.3	24.7	0		1	98.6	0.4	0		6.5	33.4	60.1	0		4.7	89.6	5.7	0		
PHF	.914	.568	.759	.000	.935	.583	.962	.375	.000	.976	.588	.840	.961	.000	.925	.639	.869	.778	.000	.886	.949
Cars	233	24	82	0	339	7	672	3	0	682	40	203	366	0	609	23	430	28	0	481	2111
% Cars	99.6	96.0	96.5	0	98.5	100	98.7	100	0	98.7	100	99.0	99.2	0	99.2	100	98.2	100	0	98.4	98.7
Heavy Vehicles	1	1	3	0	5	0	9	0	0	9	0	2	3	0	5	0	8	0	0	8	27
% Heavy Vehicles	0.4	4.0	3.5	0	1.5	0	1.3	0	0	1.3	0	1.0	0.8	0	0.8	0	1.8	0	0	1.6	1.3



PRECISION
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N/S: Springs Road/ South Road
E/W: Great Road (Route 4/62/225)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 OO
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars

	Springs Road From North				Great Road (Route 4/62/225) From East				South Road From South				Great Road (Route 4/62/225) From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
03:00 PM	34	11	15	0	0	143	1	0	14	16	60	0	9	151	4	0	458
03:15 PM	32	6	18	0	4	156	3	0	10	17	55	0	9	134	9	0	453
03:30 PM	35	4	17	0	1	157	0	0	12	26	72	0	8	144	10	0	486
03:45 PM	31	4	15	0	3	150	3	0	14	45	93	0	11	131	9	0	509
Total	132	25	65	0	8	606	7	0	50	104	280	0	37	560	32	0	1906
04:00 PM	55	8	28	0	3	157	0	0	17	44	93	0	3	112	8	0	528
04:15 PM	60	4	19	0	1	170	1	0	9	60	95	0	7	124	5	0	555
04:30 PM	55	1	19	0	3	170	2	0	9	48	93	0	4	100	9	0	513
04:45 PM	63	11	16	0	0	175	0	0	5	51	85	0	9	94	6	0	515
Total	233	24	82	0	7	672	3	0	40	203	366	0	23	430	28	0	2111
05:00 PM	49	7	10	0	3	184	0	0	10	37	88	0	15	96	7	0	506
05:15 PM	57	3	10	0	1	170	0	0	3	47	89	0	8	111	8	0	507
05:30 PM	67	7	9	0	3	174	0	0	2	33	87	0	8	124	8	0	522
05:45 PM	48	6	11	0	2	175	2	0	4	43	103	0	8	94	6	0	502
Total	221	23	40	0	9	703	2	0	19	160	367	0	39	425	29	0	2037
Grand Total	586	72	187	0	24	1981	12	0	109	467	1013	0	99	1415	89	0	6054
Apprch %	69.3	8.5	22.1	0	1.2	98.2	0.6	0	6.9	29.4	63.8	0	6.2	88.3	5.6	0	
Total %	9.7	1.2	3.1	0	0.4	32.7	0.2	0	1.8	7.7	16.7	0	1.6	23.4	1.5	0	

	Springs Road From North					Great Road (Route 4/62/225) From East					South Road From South					Great Road (Route 4/62/225) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:00 PM																					
04:00 PM	55	8	28	0	91	3	157	0	0	160	17	44	93	0	154	3	112	8	0	123	528
04:15 PM	60	4	19	0	83	1	170	1	0	172	9	60	95	0	164	7	124	5	0	136	555
04:30 PM	55	1	19	0	75	3	170	2	0	175	9	48	93	0	150	4	100	9	0	113	513
04:45 PM	63	11	16	0	90	0	175	0	0	175	5	51	85	0	141	9	94	6	0	109	515
Total Volume	233	24	82	0	339	7	672	3	0	682	40	203	366	0	609	23	430	28	0	481	2111
% App. Total	68.7	7.1	24.2	0		1	98.5	0.4	0		6.6	33.3	60.1	0		4.8	89.4	5.8	0		
PHF	.925	.545	.732	.000	.931	.583	.960	.375	.000	.974	.588	.846	.963	.000	.928	.639	.867	.778	.000	.884	.951



PRECISION
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N/S: Springs Road/ South Road
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City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 OO
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

	Springs Road From North				Great Road (Route 4/62/225) From East				South Road From South				Great Road (Route 4/62/225) From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
03:00 PM	2	0	0	0	0	2	0	0	0	0	1	0	0	5	0	0	10
03:15 PM	0	0	0	0	0	6	0	0	0	0	0	0	1	5	0	0	12
03:30 PM	0	0	0	0	0	3	0	0	0	1	2	0	0	5	1	0	12
03:45 PM	0	1	1	0	0	5	0	0	0	0	1	0	0	2	0	0	10
Total	2	1	1	0	0	16	0	0	0	1	4	0	1	17	1	0	44
04:00 PM	0	0	0	0	0	3	0	0	0	0	2	0	0	5	0	0	10
04:15 PM	0	0	1	0	0	3	0	0	0	1	1	0	0	2	0	0	8
04:30 PM	0	1	1	0	0	1	0	0	0	0	0	0	0	1	0	0	4
04:45 PM	1	0	1	0	0	2	0	0	0	1	0	0	0	0	0	0	5
Total	1	1	3	0	0	9	0	0	0	2	3	0	0	8	0	0	27
05:00 PM	0	1	0	0	0	1	0	0	0	0	1	0	0	4	0	0	7
05:15 PM	0	0	0	0	1	3	0	0	0	0	0	0	0	4	0	0	8
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
05:45 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	3
Total	0	1	0	0	1	4	0	0	0	1	1	0	0	11	0	0	19
Grand Total	3	3	4	0	1	29	0	0	0	4	8	0	1	36	1	0	90
Apprch %	30	30	40	0	3.3	96.7	0	0	0	33.3	66.7	0	2.6	94.7	2.6	0	
Total %	3.3	3.3	4.4	0	1.1	32.2	0	0	0	4.4	8.9	0	1.1	40	1.1	0	

	Springs Road From North					Great Road (Route 4/62/225) From East					South Road From South					Great Road (Route 4/62/225) From West					Int. Total
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 03:00 PM																					
03:00 PM	2	0	0	0	2	0	2	0	0	2	0	0	1	0	1	0	5	0	0	5	10
03:15 PM	0	0	0	0	0	0	6	0	0	6	0	0	0	0	0	1	5	0	0	6	12
03:30 PM	0	0	0	0	0	0	3	0	0	3	0	1	2	0	3	0	5	1	0	6	12
03:45 PM	0	1	1	0	2	0	5	0	0	5	0	0	1	0	1	0	2	0	0	2	10
Total Volume	2	1	1	0	4	0	16	0	0	16	0	1	4	0	5	1	17	1	0	19	44
% App. Total	50	25	25	0		0	100	0	0		0	20	80	0		5.3	89.5	5.3	0		
PHF	.250	.250	.250	.000	.500	.000	.667	.000	.000	.667	.000	.250	.500	.000	.417	.250	.850	.250	.000	.792	.917



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Groups Printed- Peds and Bicycles

	Springs Road From North				Great Road (Route 4/62/225) From East				South Road From South				Great Road (Route 4/62/225) From West				Int. Total
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	
03:00 PM	0	0	0	0	0	1	0	3	0	0	0	0	0	0	0	0	4
03:15 PM	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	4
03:30 PM	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	3
03:45 PM	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2
Total	0	0	0	0	0	1	0	8	0	0	0	4	0	0	0	0	13
04:00 PM	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	4
04:15 PM	1	0	0	1	0	0	0	2	0	0	0	1	0	0	0	0	5
04:30 PM	0	0	0	2	0	0	0	1	0	0	0	2	0	0	0	1	6
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Total	1	0	0	4	0	0	0	4	0	0	0	5	0	0	0	2	16
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	2
05:30 PM	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2
05:45 PM	0	0	0	2	0	0	0	2	0	0	0	2	0	0	0	1	7
Total	0	0	0	2	0	1	0	5	0	0	0	2	0	0	0	1	11
Grand Total	1	0	0	6	0	2	0	17	0	0	0	11	0	0	0	3	40
Apprch %	14.3	0	0	85.7	0	10.5	0	89.5	0	0	0	100	0	0	0	100	
Total %	2.5	0	0	15	0	5	0	42.5	0	0	0	27.5	0	0	0	7.5	

	Springs Road From North					Great Road (Route 4/62/225) From East					South Road From South					Great Road (Route 4/62/225) From West					Int. Total
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 03:45 PM																					
03:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	2
04:00 PM	0	0	0	1	1	0	0	0	1	1	0	0	0	1	1	0	0	0	1	1	4
04:15 PM	1	0	0	1	2	0	0	0	2	2	0	0	0	1	1	0	0	0	0	0	5
04:30 PM	0	0	0	2	2	0	0	0	1	1	0	0	0	2	2	0	0	0	1	1	6
Total Volume	1	0	0	4	5	0	0	0	4	4	0	0	0	6	6	0	0	0	2	2	17
% App. Total	20	0	0	80		0	0	0	100		0	0	0	100		0	0	0	100		
PHF	.250	.000	.000	.500	.625	.000	.000	.000	.500	.500	.000	.000	.000	.750	.750	.000	.000	.000	.500	.500	.708



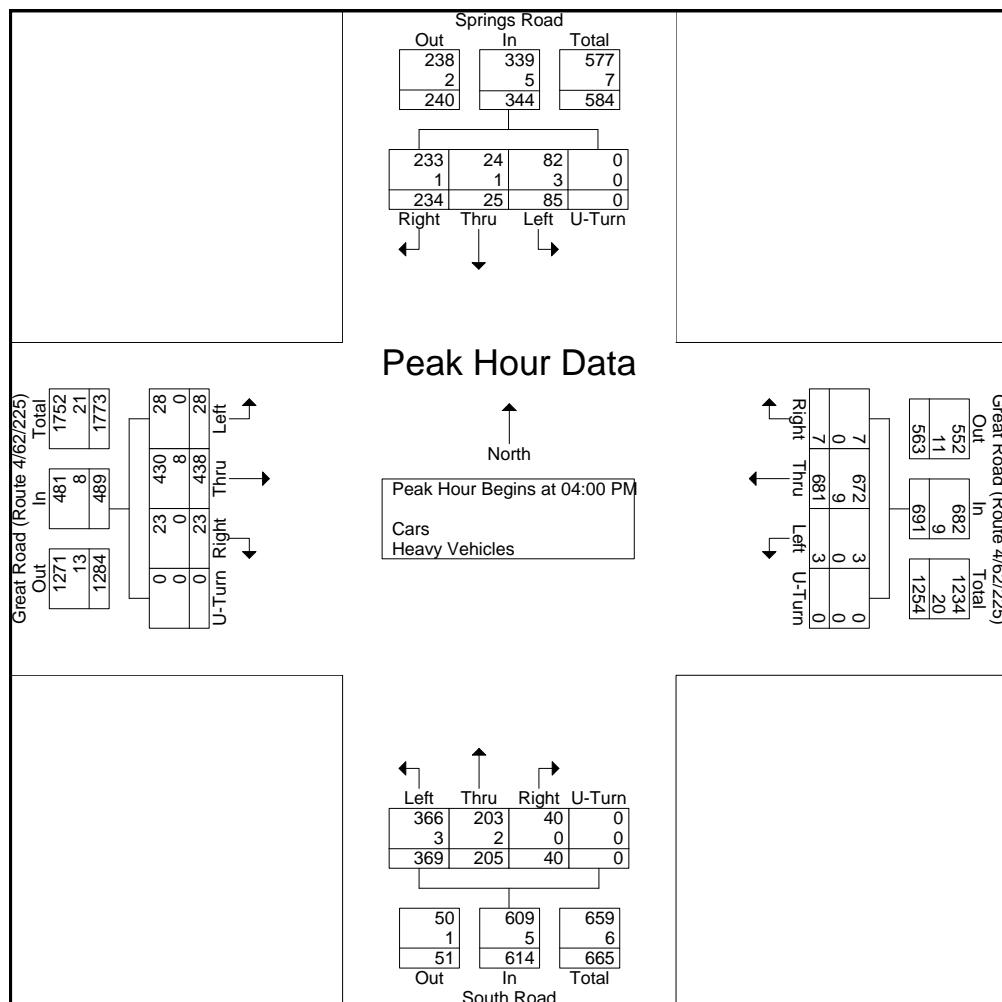
PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
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N/S: Springs Road/ South Road
E/W: Great Road (Route 4/62/225)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 OO
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

	Springs Road From North					Great Road (Route 4/62/225) From East					South Road From South					Great Road (Route 4/62/225) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:00 PM																					
04:00 PM	55	8	28	0	91	3	160	0	0	163	17	44	95	0	156	3	117	8	0	128	538
04:15 PM	60	4	20	0	84	1	173	1	0	175	9	61	96	0	166	7	126	5	0	138	563
04:30 PM	55	2	20	0	77	3	171	2	0	176	9	48	93	0	150	4	101	9	0	114	517
04:45 PM	64	11	17	0	92	0	177	0	0	177	5	52	85	0	142	9	94	6	0	109	520
Total Volume	234	25	85	0	344	7	681	3	0	691	40	205	369	0	614	23	438	28	0	489	2138
% App. Total	68	7.3	24.7	0		1	98.6	0.4	0		6.5	33.4	60.1	0		4.7	89.6	5.7	0		
PHF	.914	.568	.759	.000	.935	.583	.962	.375	.000	.976	.588	.840	.961	.000	.925	.639	.869	.778	.000	.886	.949
Cars	233	24	82	0	339	7	672	3	0	682	40	203	366	0	609	23	430	28	0	481	2111
% Cars	99.6	96.0	96.5	0	98.5	100	98.7	100	0	98.7	100	99.0	99.2	0	99.2	100	98.2	100	0	98.4	98.7
Heavy Vehicles	1	1	3	0	5	0	9	0	0	9	0	2	3	0	5	0	8	0	0	8	27
% Heavy Vehicles	0.4	4.0	3.5	0	1.5	0	1.3	0	0	1.3	0	1.0	0.8	0	0.8	0	1.8	0	0	1.6	1.3





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N/S: Jughandle/ Hartwell Avenue
E/W: Bedford Street (Route 4/225)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 AA
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	Jughandle From North				Bedford Road (Route 4/225) From East				Hartwell Avenue From South				Bedford Road (Route 4/225) From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
03:00 PM	0	67	26	0	0	212	0	0	204	0	96	0	19	240	0	0	864
03:15 PM	0	70	33	0	0	206	0	0	162	0	87	0	25	234	0	0	817
03:30 PM	0	66	33	0	0	189	0	0	199	0	111	0	24	219	0	0	841
03:45 PM	0	73	35	0	0	175	0	0	177	0	130	0	22	186	0	0	798
Total	0	276	127	0	0	782	0	0	742	0	424	0	90	879	0	0	3320
04:00 PM	0	65	32	0	0	184	0	0	192	0	119	0	36	175	0	0	803
04:15 PM	0	75	34	0	0	215	0	0	195	0	109	0	31	164	0	0	823
04:30 PM	0	68	31	0	0	210	2	0	198	0	118	0	34	196	0	0	857
04:45 PM	0	96	23	0	0	216	0	0	216	0	121	0	34	177	0	0	883
Total	0	304	120	0	0	825	2	0	801	0	467	0	135	712	0	0	3366
05:00 PM	1	89	24	0	0	206	1	0	220	0	110	1	34	176	0	0	862
05:15 PM	0	95	41	0	0	214	0	0	226	0	116	0	45	179	0	0	916
05:30 PM	1	83	39	0	0	202	0	0	206	0	103	0	43	183	0	0	860
05:45 PM	0	91	29	0	0	207	0	0	198	0	113	1	48	175	0	0	862
Total	2	358	133	0	0	829	1	0	850	0	442	2	170	713	0	0	3500
Grand Total	2	938	380	0	0	2436	3	0	2393	0	1333	2	395	2304	0	0	10186
Apprch %	0.2	71.1	28.8	0	0	99.9	0.1	0	64.2	0	35.8	0.1	14.6	85.4	0	0	
Total %	0	9.2	3.7	0	0	23.9	0	0	23.5	0	13.1	0	3.9	22.6	0	0	
Cars	2	906	375	0	0	2383	3	0	2361	0	1326	2	391	2262	0	0	10011
% Cars	100	96.6	98.7	0	0	97.8	100	0	98.7	0	99.5	100	99	98.2	0	0	98.3
Heavy Vehicles	0	32	5	0	0	53	0	0	32	0	7	0	4	42	0	0	175
% Heavy Vehicles	0	3.4	1.3	0	0	2.2	0	0	1.3	0	0.5	0	1	1.8	0	0	1.7

	Jughandle From North					Bedford Road (Route 4/225) From East					Hartwell Avenue From South					Bedford Road (Route 4/225) From West					Int. Total
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
04:45 PM	0	96	23	0	119	0	216	0	0	216	216	0	121	0	337	34	177	0	0	211	883
05:00 PM	1	89	24	0	114	0	206	1	0	207	220	0	110	1	331	34	176	0	0	210	862
05:15 PM	0	95	41	0	136	0	214	0	0	214	226	0	116	0	342	45	179	0	0	224	916
05:30 PM	1	83	39	0	123	0	202	0	0	202	206	0	103	0	309	43	183	0	0	226	860
Total Volume	2	363	127	0	492	0	838	1	0	839	868	0	450	1	1319	156	715	0	0	871	3521
% App. Total	0.4	73.8	25.8	0		0	99.9	0.1	0		65.8	0	34.1	0.1		17.9	82.1	0	0		
PHF	.500	.945	.774	.000	.904	.000	.970	.250	.000	.971	.960	.000	.930	.250	.964	.867	.977	.000	.000	.963	.961
Cars	2	356	127	0	485	0	829	1	0	830	861	0	449	1	1311	156	702	0	0	858	3484
% Cars	100	98.1	100	0	98.6	0	98.9	100	0	98.9	99.2	0	99.8	100	99.4	100	98.2	0	0	98.5	98.9
Heavy Vehicles	0	7	0	0	7	0	9	0	0	9	7	0	1	0	8	0	13	0	0	13	37
% Heavy Vehicles	0	1.9	0	0	1.4	0	1.1	0	0	1.1	0.8	0	0.2	0	0.6	0	1.8	0	0	1.5	1.1

Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1
Peak Hour for Entire Intersection Begins at 04:45 PM



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N/S: Jughandle/ Hartwell Avenue
E/W: Bedford Street (Route 4/225)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 AA
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars

	Jughandle From North				Bedford Road (Route 4/225) From East				Hartwell Avenue From South				Bedford Road (Route 4/225) From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
03:00 PM	0	61	26	0	0	202	0	0	200	0	94	0	19	235	0	0	837
03:15 PM	0	67	31	0	0	202	0	0	155	0	87	0	25	232	0	0	799
03:30 PM	0	59	33	0	0	180	0	0	194	0	111	0	24	214	0	0	815
03:45 PM	0	72	35	0	0	168	0	0	175	0	127	0	22	180	0	0	779
Total	0	259	125	0	0	752	0	0	724	0	419	0	90	861	0	0	3230
04:00 PM	0	63	31	0	0	179	0	0	192	0	119	0	33	171	0	0	788
04:15 PM	0	72	33	0	0	212	0	0	194	0	108	0	30	161	0	0	810
04:30 PM	0	65	30	0	0	207	2	0	196	0	118	0	34	193	0	0	845
04:45 PM	0	94	23	0	0	214	0	0	214	0	120	0	34	174	0	0	873
Total	0	294	117	0	0	812	2	0	796	0	465	0	131	699	0	0	3316
05:00 PM	1	86	24	0	0	202	1	0	218	0	110	1	34	174	0	0	851
05:15 PM	0	94	41	0	0	211	0	0	224	0	116	0	45	175	0	0	906
05:30 PM	1	82	39	0	0	202	0	0	205	0	103	0	43	179	0	0	854
05:45 PM	0	91	29	0	0	204	0	0	194	0	113	1	48	174	0	0	854
Total	2	353	133	0	0	819	1	0	841	0	442	2	170	702	0	0	3465
Grand Total	2	906	375	0	0	2383	3	0	2361	0	1326	2	391	2262	0	0	10011
Apprch %	0.2	70.6	29.2	0	0	99.9	0.1	0	64	0	35.9	0.1	14.7	85.3	0	0	
Total %	0	9.1	3.7	0	0	23.8	0	0	23.6	0	13.2	0	3.9	22.6	0	0	

	Jughandle From North					Bedford Road (Route 4/225) From East					Hartwell Avenue From South					Bedford Road (Route 4/225) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:45 PM																					
04:45 PM	0	94	23	0	117	0	214	0	0	214	214	0	120	0	334	34	174	0	0	208	873
05:00 PM	1	86	24	0	111	0	202	1	0	203	218	0	110	1	329	34	174	0	0	208	851
05:15 PM	0	94	41	0	135	0	211	0	0	211	224	0	116	0	340	45	175	0	0	220	906
05:30 PM	1	82	39	0	122	0	202	0	0	202	205	0	103	0	308	43	179	0	0	222	854
Total Volume	2	356	127	0	485	0	829	1	0	830	861	0	449	1	1311	156	702	0	0	858	3484
% App. Total	0.4	73.4	26.2	0		0	99.9	0.1	0		65.7	0	34.2	0.1		18.2	81.8	0	0		
PHF	.500	.947	.774	.000	.898	.000	.968	.250	.000	.970	.961	.000	.935	.250	.964	.867	.980	.000	.000	.966	.961



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N/S: Jughandle/ Hartwell Avenue
E/W: Bedford Street (Route 4/225)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 AA
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

	Jughandle From North				Bedford Road (Route 4/225) From East				Hartwell Avenue From South				Bedford Road (Route 4/225) From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
03:00 PM	0	6	0	0	0	10	0	0	4	0	2	0	0	5	0	0	27
03:15 PM	0	3	2	0	0	4	0	0	7	0	0	0	0	2	0	0	18
03:30 PM	0	7	0	0	0	9	0	0	5	0	0	0	0	5	0	0	26
03:45 PM	0	1	0	0	0	7	0	0	2	0	3	0	0	6	0	0	19
Total	0	17	2	0	0	30	0	0	18	0	5	0	0	18	0	0	90
04:00 PM	0	2	1	0	0	5	0	0	0	0	0	0	3	4	0	0	15
04:15 PM	0	3	1	0	0	3	0	0	1	0	1	0	1	3	0	0	13
04:30 PM	0	3	1	0	0	3	0	0	2	0	0	0	0	3	0	0	12
04:45 PM	0	2	0	0	0	2	0	0	2	0	1	0	0	3	0	0	10
Total	0	10	3	0	0	13	0	0	5	0	2	0	4	13	0	0	50
05:00 PM	0	3	0	0	0	4	0	0	2	0	0	0	0	2	0	0	11
05:15 PM	0	1	0	0	0	3	0	0	2	0	0	0	0	4	0	0	10
05:30 PM	0	1	0	0	0	0	0	0	1	0	0	0	0	4	0	0	6
05:45 PM	0	0	0	0	0	3	0	0	4	0	0	0	0	1	0	0	8
Total	0	5	0	0	0	10	0	0	9	0	0	0	0	11	0	0	35
Grand Total	0	32	5	0	0	53	0	0	32	0	7	0	4	42	0	0	175
Apprch %	0	86.5	13.5	0	0	100	0	0	82.1	0	17.9	0	8.7	91.3	0	0	
Total %	0	18.3	2.9	0	0	30.3	0	0	18.3	0	4	0	2.3	24	0	0	

	Jughandle From North					Bedford Road (Route 4/225) From East					Hartwell Avenue From South					Bedford Road (Route 4/225) From West					Int. Total
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
03:00 PM	0	6	0	0	6	0	10	0	0	10	4	0	2	0	6	0	5	0	0	5	27
03:15 PM	0	3	2	0	5	0	4	0	0	4	7	0	0	0	7	0	2	0	0	2	18
03:30 PM	0	7	0	0	7	0	9	0	0	9	5	0	0	0	5	0	5	0	0	5	26
03:45 PM	0	1	0	0	1	0	7	0	0	7	2	0	3	0	5	0	6	0	0	6	19
Total Volume	0	17	2	0	19	0	30	0	0	30	18	0	5	0	23	0	18	0	0	18	90
% App. Total	0	89.5	10.5	0		0	100	0	0		78.3	0	21.7	0		0	100	0	0		
PHF	.000	.607	.250	.000	.679	.000	.750	.000	.000	.750	.643	.000	.417	.000	.821	.000	.750	.000	.000	.750	.833

Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1

Peak Hour for Entire Intersection Begins at 03:00 PM



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File Name : 123082 AA
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

	Jughandle From North				Bedford Road (Route 4/225) From East				Hartwell Avenue From South				Bedford Road (Route 4/225) From West				Int. Total
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	
03:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
03:45 PM	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Total	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
04:45 PM	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Total	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	2
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Total	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	2
Grand Total	0	1	0	2	0	1	0	0	0	0	0	1	0	1	0	0	6
Apprch %	0	33.3	0	66.7	0	100	0	0	0	0	0	100	0	100	0	0	
Total %	0	16.7	0	33.3	0	16.7	0	0	0	0	0	16.7	0	16.7	0	0	

	Jughandle From North					Bedford Road (Route 4/225) From East					Hartwell Avenue From South					Bedford Road (Route 4/225) From West					Int. Total
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
04:45 PM	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1
Total Volume	0	0	0	1	1	0	1	0	0	1	0	0	0	1	1	0	0	0	0	0	3
% App. Total	0	0	0	100		0	100	0	0		0	0	0	100		0	0	0	0		
PHF	.000	.000	.000	.250	.250	.000	.250	.000	.000	.250	.000	.000	.000	.250	.250	.000	.000	.000	.000	.000	.750



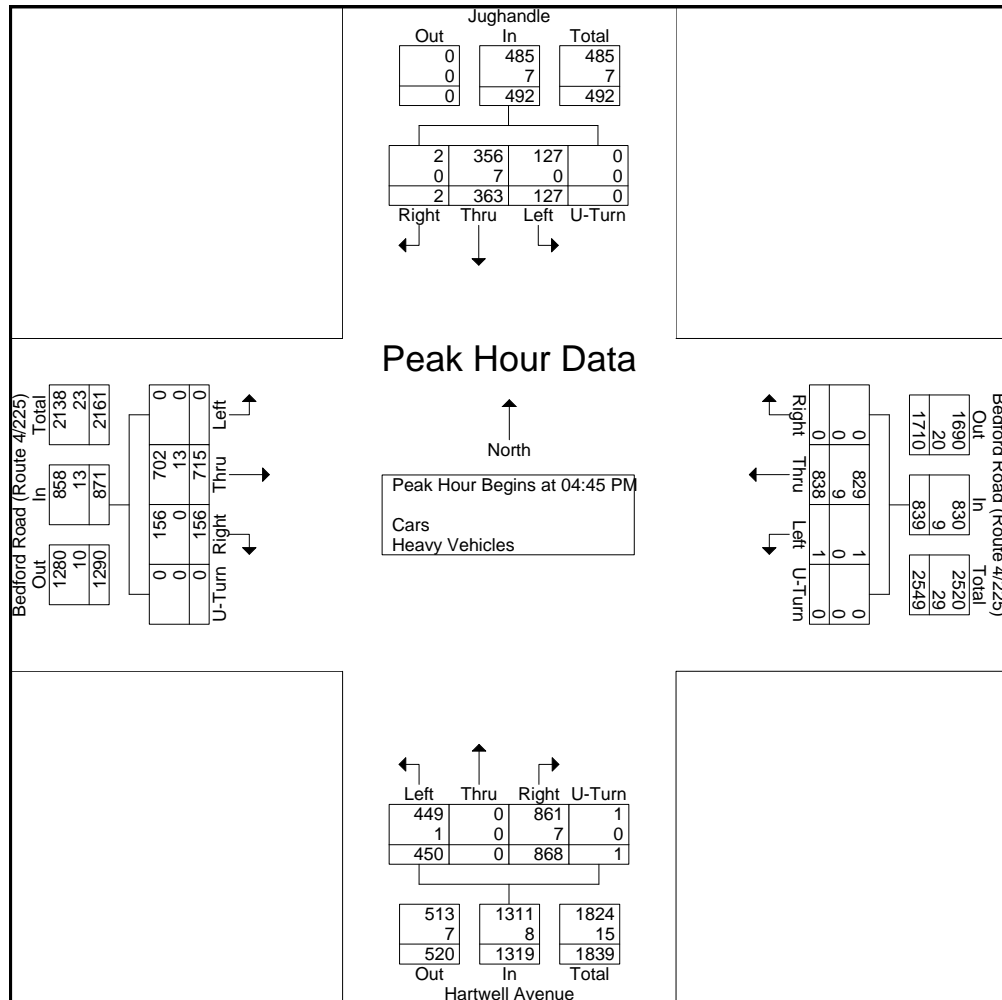
PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

N/S: Jughandle/ Hartwell Avenue
E/W: Bedford Street (Route 4/225)
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 AA
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

	Jughandle From North					Bedford Road (Route 4/225) From East					Hartwell Avenue From South					Bedford Road (Route 4/225) From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:45 PM																					
04:45 PM	0	96	23	0	119	0	216	0	0	216	216	0	121	0	337	34	177	0	0	211	883
05:00 PM	1	89	24	0	114	0	206	1	0	207	220	0	110	1	331	34	176	0	0	210	862
05:15 PM	0	95	41	0	136	0	214	0	0	214	226	0	116	0	342	45	179	0	0	224	916
05:30 PM	1	83	39	0	123	0	202	0	0	202	206	0	103	0	309	43	183	0	0	226	860
Total Volume	2	363	127	0	492	0	838	1	0	839	868	0	450	1	1319	156	715	0	0	871	3521
% App. Total	0.4	73.8	25.8	0		0	99.9	0.1	0		65.8	0	34.1	0.1		17.9	82.1	0	0		
PHF	.500	.945	.774	.000	.904	.000	.970	.250	.000	.971	.960	.000	.930	.250	.964	.867	.977	.000	.000	.963	.961
Cars	2	356	127	0	485	0	829	1	0	830	861	0	449	1	1311	156	702	0	0	858	3484
% Cars	100	98.1	100	0	98.6	0	98.9	100	0	98.9	99.2	0	99.8	100	99.4	100	98.2	0	0	98.5	98.9
Heavy Vehicles	0	7	0	0	7	0	9	0	0	9	7	0	1	0	8	0	13	0	0	13	37
% Heavy Vehicles	0	1.9	0	0	1.4	0	1.1	0	0	1.1	0.8	0	0.2	0	0.6	0	1.8	0	0	1.5	1.1





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N/S: South Road
E/W: Loomis Street/ Railroad Avenue
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 PP
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars - Heavy Vehicles

	South Road From North				Loomis Street From East				South Road From South				Railroad Avenue From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
03:00 PM	3	18	6	0	3	12	23	0	21	67	8	0	6	9	6	0	182
03:15 PM	6	24	5	0	12	18	30	0	31	63	6	1	2	20	3	0	221
03:30 PM	5	16	1	0	6	12	32	0	51	90	12	0	11	34	3	0	273
03:45 PM	11	20	5	0	5	18	32	0	36	122	14	0	11	30	14	0	318
Total	25	78	17	0	26	60	117	0	139	342	40	1	30	93	26	0	994
04:00 PM	4	19	4	0	9	17	31	0	42	119	5	0	6	26	8	0	290
04:15 PM	0	17	5	0	3	23	29	0	50	153	3	0	8	16	2	0	309
04:30 PM	0	11	5	0	4	25	35	0	61	140	4	0	4	41	7	0	337
04:45 PM	3	16	5	0	10	27	33	0	74	145	11	0	3	24	9	0	360
Total	7	63	19	0	26	92	128	0	227	557	23	0	21	107	26	0	1296
05:00 PM	4	30	5	0	2	28	22	0	116	131	19	0	5	23	4	0	389
05:15 PM	0	21	3	0	7	26	26	0	103	126	19	0	1	24	4	0	360
05:30 PM	3	23	4	0	7	21	23	0	102	117	18	0	4	38	3	0	363
05:45 PM	5	15	7	0	9	31	25	0	91	113	17	0	3	20	3	0	339
Total	12	89	19	0	25	106	96	0	412	487	73	0	13	105	14	0	1451
Grand Total	44	230	55	0	77	258	341	0	778	1386	136	1	64	305	66	0	3741
Apprch %	13.4	69.9	16.7	0	11.4	38.2	50.4	0	33.8	60.2	5.9	0	14.7	70.1	15.2	0	
Total %	1.2	6.1	1.5	0	2.1	6.9	9.1	0	20.8	37	3.6	0	1.7	8.2	1.8	0	
Cars	40	226	51	0	72	248	334	0	766	1380	118	1	62	298	65	0	3661
% Cars	90.9	98.3	92.7	0	93.5	96.1	97.9	0	98.5	99.6	86.8	100	96.9	97.7	98.5	0	97.9
Heavy Vehicles	4	4	4	0	5	10	7	0	12	6	18	0	2	7	1	0	80
% Heavy Vehicles	9.1	1.7	7.3	0	6.5	3.9	2.1	0	1.5	0.4	13.2	0	3.1	2.3	1.5	0	2.1

	South Road From North					Loomis Street From East					South Road From South					Railroad Avenue From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:45 PM																					
04:45 PM	3	16	5	0	24	10	27	33	0	70	74	145	11	0	230	3	24	9	0	36	360
05:00 PM	4	30	5	0	39	2	28	22	0	52	116	131	19	0	266	5	23	4	0	32	389
05:15 PM	0	21	3	0	24	7	26	26	0	59	103	126	19	0	248	1	24	4	0	29	360
05:30 PM	3	23	4	0	30	7	21	23	0	51	102	117	18	0	237	4	38	3	0	45	363
Total Volume	10	90	17	0	117	26	102	104	0	232	395	519	67	0	981	13	109	20	0	142	1472
% App. Total	8.5	76.9	14.5	0		11.2	44	44.8	0		40.3	52.9	6.8	0		9.2	76.8	14.1	0		
PHF	.625	.750	.850	.000	.750	.650	.911	.788	.000	.829	.851	.895	.882	.000	.922	.650	.717	.556	.000	.789	.946
Cars	10	90	16	0	116	25	101	102	0	228	389	519	60	0	968	13	109	20	0	142	1454
% Cars	100	100	94.1	0	99.1	96.2	99.0	98.1	0	98.3	98.5	100	89.6	0	98.7	100	100	100	0	100	98.8
Heavy Vehicles	0	0	1	0	1	1	1	2	0	4	6	0	7	0	13	0	0	0	0	0	18
% Heavy Vehicles	0	0	5.9	0	0.9	3.8	1.0	1.9	0	1.7	1.5	0	10.4	0	1.3	0	0	0	0	0	1.2



PRECISION
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N/S: South Road
E/W: Loomis Street/ Railroad Avenue
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 PP
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Cars

	South Road From North				Loomis Street From East				South Road From South				Railroad Avenue From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
03:00 PM	3	16	6	0	3	12	23	0	20	67	5	0	5	9	6	0	175
03:15 PM	6	24	4	0	12	16	28	0	30	63	6	1	2	19	3	0	214
03:30 PM	5	15	1	0	4	12	32	0	50	88	7	0	11	30	3	0	258
03:45 PM	7	20	4	0	5	16	32	0	35	121	13	0	10	30	14	0	307
Total	21	75	15	0	24	56	115	0	135	339	31	1	28	88	26	0	954
04:00 PM	4	18	4	0	9	14	29	0	42	118	4	0	6	25	7	0	280
04:15 PM	0	17	5	0	2	21	29	0	48	151	3	0	8	15	2	0	301
04:30 PM	0	11	4	0	4	25	34	0	61	140	3	0	4	41	7	0	334
04:45 PM	3	16	5	0	9	27	33	0	73	145	8	0	3	24	9	0	355
Total	7	62	18	0	24	87	125	0	224	554	18	0	21	105	25	0	1270
05:00 PM	4	30	4	0	2	28	21	0	112	131	18	0	5	23	4	0	382
05:15 PM	0	21	3	0	7	26	25	0	102	126	17	0	1	24	4	0	356
05:30 PM	3	23	4	0	7	20	23	0	102	117	17	0	4	38	3	0	361
05:45 PM	5	15	7	0	8	31	25	0	91	113	17	0	3	20	3	0	338
Total	12	89	18	0	24	105	94	0	407	487	69	0	13	105	14	0	1437
Grand Total	40	226	51	0	72	248	334	0	766	1380	118	1	62	298	65	0	3661
Apprch %	12.6	71.3	16.1	0	11	37.9	51.1	0	33.8	60.9	5.2	0	14.6	70.1	15.3	0	
Total %	1.1	6.2	1.4	0	2	6.8	9.1	0	20.9	37.7	3.2	0	1.7	8.1	1.8	0	

	South Road From North					Loomis Street From East					South Road From South					Railroad Avenue From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:45 PM																					
04:45 PM	3	16	5	0	24	9	27	33	0	69	73	145	8	0	226	3	24	9	0	36	355
05:00 PM	4	30	4	0	38	2	28	21	0	51	112	131	18	0	261	5	23	4	0	32	382
05:15 PM	0	21	3	0	24	7	26	25	0	58	102	126	17	0	245	1	24	4	0	29	356
05:30 PM	3	23	4	0	30	7	20	23	0	50	102	117	17	0	236	4	38	3	0	45	361
Total Volume	10	90	16	0	116	25	101	102	0	228	389	519	60	0	968	13	109	20	0	142	1454
% App. Total	8.6	77.6	13.8	0		11	44.3	44.7	0		40.2	53.6	6.2	0		9.2	76.8	14.1	0		
PHF	.625	.750	.800	.000	.763	.694	.902	.773	.000	.826	.868	.895	.833	.000	.927	.650	.717	.556	.000	.789	.952



PRECISION
D A T A
INDUSTRIES, LLC

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Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

N/S: South Road
E/W: Loomis Street/ Railroad Avenue
City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 PP
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Heavy Vehicles

	South Road From North				Loomis Street From East				South Road From South				Railroad Avenue From West				Int. Total
Start Time	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	Right	Thru	Left	U-Turn	
03:00 PM	0	2	0	0	0	0	0	0	1	0	3	0	1	0	0	0	7
03:15 PM	0	0	1	0	0	2	2	0	1	0	0	0	0	1	0	0	7
03:30 PM	0	1	0	0	2	0	0	0	1	2	5	0	0	4	0	0	15
03:45 PM	4	0	1	0	0	2	0	0	1	1	1	0	1	0	0	0	11
Total	4	3	2	0	2	4	2	0	4	3	9	0	2	5	0	0	40
04:00 PM	0	1	0	0	0	3	2	0	0	1	1	0	0	1	1	0	10
04:15 PM	0	0	0	0	1	2	0	0	2	2	0	0	0	1	0	0	8
04:30 PM	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	3
04:45 PM	0	0	0	0	1	0	0	0	1	0	3	0	0	0	0	0	5
Total	0	1	1	0	2	5	3	0	3	3	5	0	0	2	1	0	26
05:00 PM	0	0	1	0	0	0	1	0	4	0	1	0	0	0	0	0	7
05:15 PM	0	0	0	0	0	0	1	0	1	0	2	0	0	0	0	0	4
05:30 PM	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	2
05:45 PM	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Total	0	0	1	0	1	1	2	0	5	0	4	0	0	0	0	0	14
Grand Total	4	4	4	0	5	10	7	0	12	6	18	0	2	7	1	0	80
Apprch %	33.3	33.3	33.3	0	22.7	45.5	31.8	0	33.3	16.7	50	0	20	70	10	0	
Total %	5	5	5	0	6.2	12.5	8.8	0	15	7.5	22.5	0	2.5	8.8	1.2	0	

	South Road From North					Loomis Street From East					South Road From South					Railroad Avenue From West					Int. Total
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 03:30 PM																					
03:30 PM	0	1	0	0	1	2	0	0	0	2	1	2	5	0	8	0	4	0	0	4	15
03:45 PM	4	0	1	0	5	0	2	0	0	2	1	1	1	0	3	1	0	0	0	1	11
04:00 PM	0	1	0	0	1	0	3	2	0	5	0	1	1	0	2	0	1	1	0	2	10
04:15 PM	0	0	0	0	0	1	2	0	0	3	2	2	0	0	4	0	1	0	0	1	8
Total Volume	4	2	1	0	7	3	7	2	0	12	4	6	7	0	17	1	6	1	0	8	44
% App. Total	57.1	28.6	14.3	0		25	58.3	16.7	0		23.5	35.3	41.2	0		12.5	75	12.5	0		
PHF	.250	.500	.250	.000	.350	.375	.583	.250	.000	.600	.500	.750	.350	.000	.531	.250	.375	.250	.000	.500	.733



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N/S: South Road
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City, State: Bedford, MA
Client: Toole Engineering/ C. Fink

File Name : 123082 PP
Site Code : TBA
Start Date : 11/13/2012
Page No : 1

Groups Printed- Peds and Bicycles

	South Road From North				Loomis Street From East				South Road From South				Railroad Avenue From West				Int. Total
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	
03:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:15 PM	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	3
03:30 PM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2
03:45 PM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Total	0	0	0	1	0	0	0	2	0	0	1	1	0	0	0	1	6
04:00 PM	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
04:15 PM	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	2
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	3
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	7	0	0	0	0	2	0	0	0	0	0	9
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2
Total	0	0	0	0	0	7	0	0	0	0	2	1	0	0	0	1	11
Grand Total	0	0	0	1	0	7	0	4	0	0	3	3	0	0	0	2	20
Apprch %	0	0	0	100	0	63.6	0	36.4	0	0	50	50	0	0	0	100	
Total %	0	0	0	5	0	35	0	20	0	0	15	15	0	0	0	10	

	South Road From North					Loomis Street From East					South Road From South					Railroad Avenue From West					Int. Total
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 05:00 PM																					
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	7	0	0	7	0	0	2	0	2	0	0	0	0	0	9
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	1	1	2
Total Volume	0	0	0	0	0	0	7	0	0	7	0	0	2	1	3	0	0	0	1	1	11
% App. Total	0	0	0	0		0	100	0	0		0	0	66.7	33.3		0	0	0	100		
PHF	.000	.000	.000	.000	.000	.000	.250	.000	.000	.250	.000	.000	.250	.250	.375	.000	.000	.000	.250	.250	.306



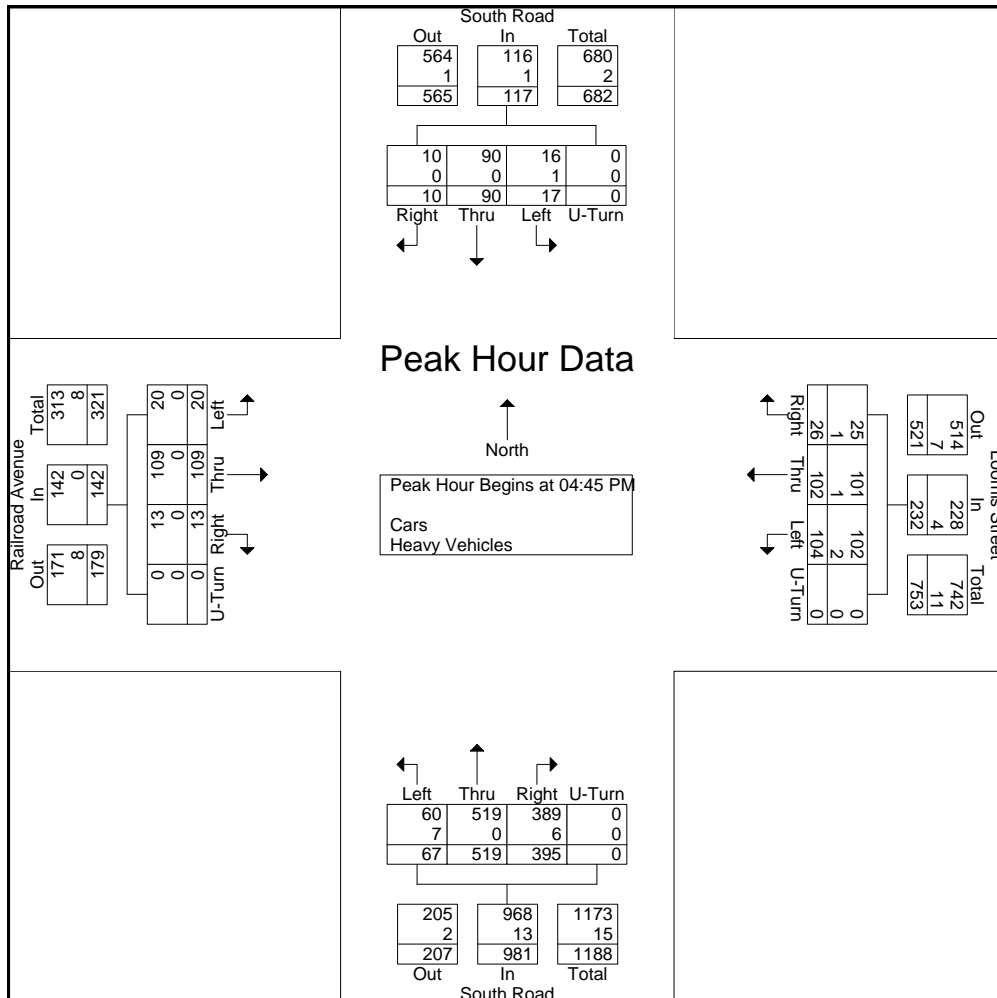
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	South Road From North					Loomis Street From East					South Road From South					Railroad Avenue From West					
Start Time	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Right	Thru	Left	U-Turn	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:45 PM																					
04:45 PM	3	16	5	0	24	10	27	33	0	70	74	145	11	0	230	3	24	9	0	36	360
05:00 PM	4	30	5	0	39	2	28	22	0	52	116	131	19	0	266	5	23	4	0	32	389
05:15 PM	0	21	3	0	24	7	26	26	0	59	103	126	19	0	248	1	24	4	0	29	360
05:30 PM	3	23	4	0	30	7	21	23	0	51	102	117	18	0	237	4	38	3	0	45	363
Total Volume	10	90	17	0	117	26	102	104	0	232	395	519	67	0	981	13	109	20	0	142	1472
% App. Total	8.5	76.9	14.5	0		11.2	44	44.8	0		40.3	52.9	6.8	0		9.2	76.8	14.1	0		
PHF	.625	.750	.850	.000	.750	.650	.911	.788	.000	.829	.851	.895	.882	.000	.922	.650	.717	.556	.000	.789	.946
Cars	10	90	16	0	116	25	101	102	0	228	389	519	60	0	968	13	109	20	0	142	1454
% Cars	100	100	94.1	0	99.1	96.2	99.0	98.1	0	98.3	98.5	100	89.6	0	98.7	100	100	100	0	100	98.8
Heavy Vehicles	0	0	1	0	1	1	1	2	0	4	6	0	7	0	13	0	0	0	0	0	18
% Heavy Vehicles	0	0	5.9	0	0.9	3.8	1.0	1.9	0	1.7	1.5	0	10.4	0	1.3	0	0	0	0	0	1.2



Appendix C-3

2012 Automatic Traffic Recorder (ATR) Counts



PRECISION
D A T A
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133213 A Class
Site Code: TBA

Massachusetts Avenue (Route 2A)
east of Marrett Street
City, State: Lexington, MA
Client: Toole Design/ C. Fink

WB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
02/26/1														
3	0	11	2	0	0	0	0	0	0	0	0	0	0	13
01:00	0	8	0	0	0	0	0	0	1	0	0	0	0	9
02:00	0	6	3	0	0	0	0	0	0	0	0	0	0	9
03:00	0	12	1	0	0	0	0	0	0	0	0	0	0	13
04:00	0	15	5	0	0	0	0	0	0	0	0	0	0	20
05:00	0	112	22	9	2	1	0	2	2	1	0	0	0	151
06:00	1	385	66	7	14	3	0	4	2	0	0	0	0	482
07:00	2	717	61	4	12	1	0	1	2	0	0	0	0	800
08:00	7	537	54	5	15	3	1	2	3	0	0	0	0	627
09:00	2	480	59	8	16	3	1	2	3	0	0	0	0	574
10:00	1	283	42	7	9	1	1	3	4	1	0	0	0	352
11:00	2	332	51	1	9	2	1	2	1	0	0	0	1	402
12 PM	1	398	54	6	4	3	2	3	6	2	0	0	0	479
13:00	0	393	60	3	5	3	1	3	1	1	0	0	0	470
14:00	0	444	61	9	4	1	0	1	5	0	0	0	0	525
15:00	0	510	66	1	8	0	0	1	0	0	0	0	0	586
16:00	6	659	63	2	5	3	0	2	0	0	0	0	0	740
17:00	3	799	44	2	7	0	0	0	0	0	0	0	0	855
18:00	2	645	30	2	2	0	0	0	0	0	0	0	0	681
19:00	1	341	22	1	0	0	0	0	1	0	0	0	0	366
20:00	0	224	18	0	3	0	0	0	0	1	0	0	0	246
21:00	0	173	11	1	1	0	0	0	0	0	0	0	0	186
22:00	0	88	15	0	0	0	0	0	0	0	0	0	0	103
23:00	0	42	5	0	0	0	0	0	0	0	0	0	0	47
Total	28	7614	815	68	116	24	7	26	31	6	0	0	1	8736
Percent	0.3%	87.2%	9.3%	0.8%	1.3%	0.3%	0.1%	0.3%	0.4%	0.1%	0.0%	0.0%	0.0%	
AM Peak	08:00	07:00	06:00	05:00	09:00	06:00	08:00	06:00	10:00	05:00			11:00	07:00
Vol.	7	717	66	9	16	3	1	4	4	1			1	800
PM Peak	16:00	17:00	15:00	14:00	15:00	12:00	12:00	12:00	12:00	12:00				17:00
Vol.	6	799	66	9	8	3	2	3	6	2				855



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133213 A Class
Site Code: TBA

WB

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02/27/1														
3	0	14	2	0	0	0	0	0	0	0	0	0	0	16
01:00	0	6	2	0	0	0	0	0	0	0	0	0	0	8
02:00	0	6	0	0	0	0	0	0	0	0	0	0	0	6
03:00	0	10	4	0	1	0	0	0	0	0	0	0	0	15
04:00	0	15	4	0	0	0	0	0	3	0	0	0	0	22
05:00	0	101	24	7	2	3	0	0	1	2	0	0	0	140
06:00	1	377	53	8	10	1	1	3	0	0	0	1	0	455
07:00	4	642	63	5	9	1	0	3	0	0	0	0	0	727
08:00	3	529	58	4	10	3	1	0	0	0	0	0	0	608
09:00	2	443	77	13	16	1	0	0	1	0	0	0	0	553
10:00	2	277	54	5	7	2	1	6	4	0	0	0	0	358
11:00	0	300	39	6	9	3	0	0	4	0	0	0	0	361
12 PM	1	333	36	5	14	1	1	1	5	1	0	0	0	398
13:00	1	345	53	3	10	2	1	4	2	0	0	0	0	421
14:00	1	389	49	10	6	0	1	1	1	0	0	0	0	458
15:00	0	270	32	0	3	2	0	2	1	0	0	0	0	310
16:00	7	634	60	1	5	2	0	1	2	0	0	0	0	712
17:00	4	776	62	2	8	2	0	1	4	0	0	0	0	859
18:00	1	686	54	2	5	0	0	0	0	0	0	0	0	748
19:00	1	287	29	1	0	0	0	0	0	0	0	0	0	318
20:00	0	249	18	0	1	0	0	0	1	0	0	0	0	269
21:00	0	184	13	1	2	0	0	1	0	0	0	0	0	201
22:00	0	70	4	1	1	0	0	0	0	0	0	0	0	76
23:00	0	25	6	0	0	0	0	0	0	0	0	0	0	31
Total	28	6968	796	74	119	23	6	23	29	3	0	1	0	8070
Percent	0.3%	86.3%	9.9%	0.9%	1.5%	0.3%	0.1%	0.3%	0.4%	0.0%	0.0%	0.0%	0.0%	
AM Peak	07:00	07:00	09:00	09:00	09:00	05:00	06:00	10:00	10:00	05:00		06:00		07:00
Vol.	4	642	77	13	16	3	1	6	4	2		1		727
PM Peak	16:00	17:00	17:00	14:00	12:00	13:00	12:00	13:00	12:00	12:00				17:00
Vol.	7	776	62	10	14	2	1	4	5	1				859



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WB

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02/28/1														
3	0	21	1	0	2	0	0	0	0	0	0	0	0	24
01:00	0	10	2	0	1	0	0	0	0	0	0	0	0	13
02:00	0	7	0	0	1	0	0	0	1	0	0	0	0	9
03:00	0	9	1	0	0	0	0	0	0	0	0	0	0	10
04:00	0	14	6	1	1	0	0	0	1	0	0	0	0	23
05:00	0	120	23	9	5	0	0	0	1	1	0	0	0	159
06:00	0	416	72	4	9	2	0	3	4	0	0	0	0	510
07:00	0	687	46	7	12	5	0	4	1	1	0	0	0	763
08:00	4	570	70	6	13	2	2	1	2	0	0	0	0	670
09:00	1	445	47	4	16	1	0	1	0	0	0	0	0	515
10:00	1	273	40	5	14	2	1	2	5	1	0	0	0	344
11:00	0	303	55	7	14	1	1	4	1	0	0	0	0	386
12 PM	2	419	43	6	12	8	2	2	2	0	0	0	0	496
13:00	1	397	45	2	9	4	1	1	1	1	0	0	0	462
14:00	1	461	61	10	3	7	1	2	4	1	0	0	0	551
15:00	5	557	59	2	11	1	1	0	1	0	0	0	0	637
16:00	1	746	75	4	9	1	0	2	0	0	0	0	0	838
17:00	1	809	50	2	7	1	0	1	0	0	0	0	0	871
18:00	2	592	37	2	2	0	0	1	0	0	0	0	0	636
19:00	0	368	25	1	1	0	0	1	0	0	0	0	0	396
20:00	0	255	19	0	1	0	0	0	0	0	0	0	0	275
21:00	0	182	14	2	1	1	0	0	0	0	0	0	0	200
22:00	0	105	7	0	1	0	0	0	0	0	0	0	0	113
23:00	0	49	3	0	3	0	0	0	1	0	0	0	0	56
Total	19	7815	801	74	148	36	9	25	25	5	0	0	0	8957
Percent	0.2%	87.3%	8.9%	0.8%	1.7%	0.4%	0.1%	0.3%	0.3%	0.1%	0.0%	0.0%	0.0%	
AM Peak	08:00	07:00	06:00	05:00	09:00	07:00	08:00	07:00	10:00	05:00				07:00
Vol.	4	687	72	9	16	5	2	4	5	1				763
PM Peak	15:00	17:00	16:00	14:00	12:00	12:00	12:00	12:00	14:00	13:00				17:00
Vol.	5	809	75	10	12	8	2	2	4	1				871



PRECISION
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WB

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03/01/1														
3	0	20	4	0	0	0	0	0	0	0	0	0	0	24
01:00	0	9	1	0	0	0	0	0	0	0	0	0	0	10
02:00	0	8	1	0	1	0	0	0	0	0	0	0	0	10
03:00	0	9	0	0	0	0	0	0	0	0	0	0	0	9
04:00	0	18	5	0	1	0	0	1	1	0	0	0	0	26
05:00	0	104	21	9	2	1	0	2	2	0	0	0	0	141
06:00	1	373	67	5	9	0	0	3	4	0	0	0	0	462
07:00	5	660	65	4	10	2	2	1	2	0	0	0	0	751
08:00	4	521	64	5	10	5	0	0	0	0	0	0	0	609
09:00	4	400	47	9	16	4	2	3	4	0	0	0	0	489
10:00	0	331	56	4	13	4	1	5	0	1	0	0	0	415
11:00	0	353	38	3	5	1	1	2	3	0	0	0	0	406
12 PM	1	389	55	6	11	1	1	2	3	1	0	0	0	470
13:00	5	398	60	3	5	4	0	0	2	0	0	0	0	477
14:00	1	481	55	8	7	2	1	1	0	0	0	0	0	556
15:00	0	579	63	1	9	1	0	0	0	0	0	0	0	653
16:00	6	668	47	3	8	2	0	3	0	0	0	0	0	737
17:00	4	724	36	5	6	2	0	2	0	0	0	0	0	779
18:00	1	573	36	1	4	0	0	0	0	0	0	0	0	615
19:00	2	305	17	1	2	0	0	0	0	0	0	0	0	327
20:00	2	205	13	0	1	0	0	0	0	0	0	0	0	221
21:00	0	191	4	2	1	0	0	0	0	0	0	0	0	198
22:00	0	193	9	0	1	0	0	0	1	0	0	0	0	204
23:00	0	73	3	0	0	0	0	0	1	0	0	0	0	77
Total	36	7585	767	69	122	29	8	25	23	2	0	0	0	8666
Percent	0.4%	87.5%	8.9%	0.8%	1.4%	0.3%	0.1%	0.3%	0.3%	0.0%	0.0%	0.0%	0.0%	
AM Peak	07:00	07:00	06:00	05:00	09:00	08:00	07:00	10:00	06:00	10:00				07:00
Vol.	5	660	67	9	16	5	2	5	4	1				751
PM Peak	16:00	17:00	15:00	14:00	12:00	13:00	12:00	16:00	12:00	12:00				17:00
Vol.	6	724	63	8	11	4	1	3	3	1				779



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WB

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03/02/1														
3	1	29	3	0	0	0	0	0	0	0	0	0	0	33
01:00	0	20	2	0	0	0	0	0	0	0	0	0	0	22
02:00	0	6	0	0	0	0	0	0	0	0	0	0	0	6
03:00	0	7	4	0	0	0	0	0	1	0	0	0	0	12
04:00	0	5	4	0	1	0	0	0	0	0	0	0	0	10
05:00	0	25	5	2	3	0	0	0	0	1	0	0	0	36
06:00	0	105	19	1	3	0	0	1	0	0	0	0	0	129
07:00	0	191	28	1	2	0	0	0	1	1	0	0	0	224
08:00	1	232	23	2	6	0	0	1	1	1	0	0	0	267
09:00	1	269	26	3	3	1	0	1	1	0	0	0	0	305
10:00	1	304	29	4	4	0	0	0	2	0	0	0	0	344
11:00	1	391	19	2	1	0	0	0	1	0	0	0	0	415
12 PM	1	421	41	2	4	0	0	1	0	0	0	0	0	470
13:00	5	425	35	3	4	0	0	0	0	0	0	0	0	472
14:00	5	439	29	3	3	0	0	0	0	0	0	0	0	479
15:00	0	439	28	4	2	1	0	0	1	0	0	0	0	475
16:00	2	378	25	2	4	0	0	0	0	0	0	0	0	411
17:00	0	344	14	2	2	0	0	1	0	0	0	0	0	363
18:00	0	323	18	2	2	0	0	0	0	0	0	0	0	345
19:00	0	201	13	2	1	0	0	0	0	0	0	0	0	217
20:00	0	160	9	0	1	0	0	0	0	0	0	0	0	170
21:00	0	192	21	0	1	0	0	0	0	0	0	0	0	214
22:00	0	120	17	0	0	0	0	0	0	0	0	0	0	137
23:00	0	104	4	0	0	0	0	0	0	0	0	0	0	108
Total	18	5130	416	35	47	2	0	5	8	3	0	0	0	5664
Percent	0.3%	90.6%	7.3%	0.6%	0.8%	0.0%	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	
AM Peak	00:00	11:00	10:00	10:00	08:00	09:00		06:00	10:00	05:00				11:00
Vol.	1	391	29	4	6	1		1	2	1				415
PM Peak	13:00	14:00	12:00	15:00	12:00	15:00		12:00	15:00					14:00
Vol.	5	439	41	4	4	1		1	1					479



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WB

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03/03/1														
3	0	41	3	0	0	0	0	0	0	0	0	0	0	44
01:00	0	14	0	0	1	0	0	0	0	0	0	0	0	15
02:00	0	9	1	0	0	0	0	0	0	0	0	0	0	10
03:00	0	7	0	0	0	0	0	0	0	0	0	0	0	7
04:00	0	9	2	0	0	0	0	0	0	0	0	0	0	11
05:00	0	23	5	0	0	0	0	0	0	0	0	0	0	28
06:00	0	63	14	0	0	0	0	0	1	0	0	0	0	78
07:00	0	139	16	1	1	0	0	0	0	1	0	0	0	158
08:00	0	146	11	0	1	0	0	0	1	1	0	0	0	160
09:00	0	207	20	0	4	0	0	0	0	0	0	0	0	231
10:00	1	315	19	2	3	0	0	0	0	0	0	0	0	340
11:00	5	295	23	0	0	1	0	1	0	0	0	0	0	325
12 PM	2	419	25	0	2	0	0	0	0	0	0	0	0	448
13:00	2	407	23	0	5	0	0	0	0	0	0	0	0	437
14:00	0	381	34	1	1	2	0	1	0	0	0	0	0	420
15:00	0	385	25	1	1	0	0	0	0	0	0	0	0	412
16:00	3	385	25	0	5	0	0	0	0	0	0	0	0	418
17:00	0	285	29	0	1	0	0	0	0	0	0	0	0	315
18:00	1	254	17	1	0	0	0	0	0	0	0	0	0	273
19:00	1	191	17	1	3	0	0	0	1	0	0	0	0	214
20:00	1	143	13	0	2	0	0	0	0	0	0	0	0	159
21:00	0	92	6	0	1	0	0	0	0	0	0	0	0	99
22:00	0	41	7	0	0	0	0	0	0	0	0	0	0	48
23:00	0	24	0	0	0	0	0	0	0	0	0	0	0	24
Total	16	4275	335	7	31	3	0	2	3	2	0	0	0	4674
Percent	0.3%	91.5%	7.2%	0.1%	0.7%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	
AM Peak	11:00	10:00	11:00	10:00	09:00	11:00		11:00	06:00	07:00				10:00
Vol.	5	315	23	2	4	1		1	1	1				340
PM Peak	16:00	12:00	14:00	14:00	13:00	14:00		14:00	19:00					12:00
Vol.	3	419	34	1	5	2		1	1					448



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WB

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03/04/1														
3	0	12	3	0	0	0	0	0	0	0	0	0	0	15
01:00	0	6	0	0	0	0	0	0	0	0	0	0	0	6
02:00	0	3	0	0	0	0	0	0	0	0	0	0	0	3
03:00	0	4	2	0	1	0	0	0	0	0	0	0	0	7
04:00	0	17	5	0	0	0	0	0	0	0	0	0	0	22
05:00	1	132	27	7	3	0	0	1	4	0	0	0	0	175
06:00	1	415	67	6	10	3	0	1	1	0	0	0	0	504
07:00	5	629	47	5	8	4	0	2	1	1	0	0	0	702
08:00	6	561	45	6	14	3	0	1	2	0	0	0	0	638
09:00	2	352	55	4	8	1	0	0	3	1	0	0	0	426
10:00	0	273	43	5	15	3	0	2	1	2	0	0	0	344
11:00	1	322	44	3	11	4	1	2	1	0	0	0	0	389
12 PM	1	360	44	4	11	5	2	4	2	2	0	0	0	435
13:00	2	391	55	3	11	5	0	5	3	0	0	0	0	475
14:00	1	451	60	7	8	2	0	2	1	0	0	0	0	532
15:00	4	496	73	1	10	2	0	1	1	0	0	0	0	588
16:00	2	644	81	4	6	1	0	0	0	0	0	0	0	738
17:00	3	796	42	2	5	2	0	2	1	1	0	0	0	854
18:00	1	584	29	2	7	1	0	1	0	0	0	0	0	625
19:00	0	306	27	1	2	0	0	0	0	0	0	0	0	336
20:00	0	180	11	0	3	0	0	0	0	1	0	0	0	195
21:00	0	157	13	1	0	0	0	0	0	0	0	0	0	171
22:00	0	78	4	0	0	0	0	0	0	0	0	0	0	82
23:00	0	37	3	2	1	0	0	0	0	0	0	0	0	43
Total	30	7206	780	63	134	36	3	24	21	8	0	0	0	8305
Percent	0.4%	86.8%	9.4%	0.8%	1.6%	0.4%	0.0%	0.3%	0.3%	0.1%	0.0%	0.0%	0.0%	
AM Peak	08:00	07:00	06:00	05:00	10:00	07:00	11:00	07:00	05:00	10:00				07:00
Vol.	6	629	67	7	15	4	1	2	4	2				702
PM Peak	15:00	17:00	16:00	14:00	12:00	12:00	12:00	13:00	13:00	12:00				17:00
Vol.	4	796	81	7	11	5	2	5	3	2				854
Total		46593	4710	390	717	153	33	130	140	29	0	1	1	53072



PRECISION
D A T A
INDUSTRIES, LLC

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Massachusetts Avenue (Route 2A)
east of Marrett Street
City, State: Lexington, MA
Client: Toole Design/ C. Fink

133213 A Class
Site Code: TBA

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
02/26/1														
3	0	12	1	0	1	0	0	0	0	0	0	0	0	14
01:00	0	4	1	0	0	0	0	0	0	0	0	0	0	5
02:00	0	5	0	0	1	0	0	0	0	0	0	0	0	6
03:00	0	3	3	0	0	0	0	0	1	0	0	0	0	7
04:00	0	19	6	0	3	0	0	0	2	0	0	0	0	30
05:00	0	82	18	0	3	0	0	0	2	0	0	0	0	105
06:00	1	321	45	4	5	1	0	0	1	0	0	0	0	378
07:00	5	641	72	12	4	2	0	2	1	0	0	0	0	739
08:00	3	829	62	4	15	1	0	1	5	0	0	0	0	920
09:00	4	545	61	3	4	2	0	2	3	0	0	0	0	624
10:00	0	350	50	3	10	3	0	7	4	1	0	0	0	428
11:00	0	334	68	6	8	1	0	6	1	0	0	0	0	424
12 PM	1	329	56	1	8	2	0	2	2	0	0	0	0	401
13:00	0	349	50	4	3	1	1	0	4	0	0	0	0	412
14:00	0	399	54	8	3	2	0	2	1	0	0	0	0	469
15:00	1	561	70	4	6	2	0	2	1	0	0	0	0	647
16:00	3	505	45	6	4	0	0	1	1	0	0	0	0	565
17:00	2	510	42	3	1	2	0	0	0	0	0	0	0	560
18:00	2	373	36	2	3	0	0	0	0	0	0	0	0	416
19:00	0	235	22	1	2	0	0	0	0	0	0	0	0	260
20:00	1	154	17	0	0	0	0	0	0	0	0	0	0	172
21:00	0	81	4	0	1	0	0	0	1	0	0	0	0	87
22:00	0	51	14	1	0	0	0	0	0	0	0	0	0	66
23:00	0	43	4	0	0	0	0	0	0	0	0	0	0	47
Total	23	6735	801	62	85	19	1	25	30	1	0	0	0	7782
Percent	0.3%	86.5%	10.3%	0.8%	1.1%	0.2%	0.0%	0.3%	0.4%	0.0%	0.0%	0.0%	0.0%	
AM Peak	07:00	08:00	07:00	07:00	08:00	10:00		10:00	08:00	10:00				08:00
Vol.	5	829	72	12	15	3		7	5	1				920
PM Peak	16:00	15:00	15:00	14:00	12:00	12:00	13:00	12:00	13:00					15:00
Vol.	3	561	70	8	8	2	1	2	4					647



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Massachusetts Avenue (Route 2A)
east of Marrett Street
City, State: Lexington, MA
Client: Toole Design/ C. Fink

133213 A Class
Site Code: TBA

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
02/27/1														
3	0	30	7	0	1	0	0	0	0	0	0	0	0	38
01:00	0	8	2	0	1	0	0	0	0	1	0	0	0	12
02:00	0	8	0	1	0	0	0	0	1	0	0	0	0	10
03:00	0	8	3	0	1	0	0	0	0	0	0	0	0	12
04:00	0	15	8	0	1	0	0	0	3	0	0	0	0	27
05:00	0	74	17	1	1	0	0	0	0	0	0	0	0	93
06:00	2	303	34	3	2	2	0	0	1	0	0	0	0	347
07:00	6	689	65	14	8	3	0	1	2	0	0	0	0	788
08:00	2	851	65	5	8	3	0	0	1	0	0	0	0	935
09:00	2	536	65	4	7	0	0	0	0	0	0	0	0	614
10:00	2	285	37	3	10	2	0	1	1	0	1	0	0	342
11:00	0	285	63	9	9	2	0	0	4	0	0	0	0	372
12 PM	2	299	41	7	5	1	0	1	2	0	0	0	0	358
13:00	1	258	47	3	8	2	0	0	0	1	0	0	0	320
14:00	3	352	57	4	8	2	0	3	1	2	0	0	0	432
15:00	7	365	58	4	6	0	0	3	0	0	0	0	0	443
16:00	3	453	47	5	2	3	0	1	0	0	0	0	0	514
17:00	5	442	37	2	1	0	0	0	0	0	0	0	0	487
18:00	1	351	26	3	2	0	0	0	1	0	0	0	0	384
19:00	0	214	22	1	2	0	0	1	0	0	0	0	0	240
20:00	0	134	19	0	1	1	0	0	1	0	0	0	0	156
21:00	0	81	13	0	0	0	0	0	0	0	0	0	0	94
22:00	0	47	10	1	0	0	0	0	1	0	0	0	0	59
23:00	0	36	3	0	0	0	0	0	0	0	0	0	0	39
Total	36	6124	746	70	84	21	0	11	19	4	1	0	0	7116
Percent	0.5%	86.1%	10.5%	1.0%	1.2%	0.3%	0.0%	0.2%	0.3%	0.1%	0.0%	0.0%	0.0%	
AM Peak	07:00	08:00	07:00	07:00	10:00	07:00		07:00	11:00	01:00	10:00			08:00
Vol.	6	851	65	14	10	3		1	4	1	1			935
PM Peak	15:00	16:00	15:00	12:00	13:00	16:00		14:00	12:00	14:00				16:00
Vol.	7	453	58	7	8	3		3	2	2				514



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Massachusetts Avenue (Route 2A)
east of Marrett Street
City, State: Lexington, MA
Client: Toole Design/ C. Fink

133213 A Class
Site Code: TBA

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
02/28/1														
3	0	13	0	0	1	0	0	0	0	0	0	0	0	14
01:00	0	5	0	1	0	0	0	0	0	0	0	0	0	6
02:00	0	12	2	1	1	0	0	0	0	0	0	0	0	16
03:00	0	6	2	0	0	0	0	0	2	0	0	0	0	10
04:00	0	12	7	0	3	0	0	0	2	0	0	0	0	24
05:00	0	82	13	0	3	1	0	0	3	0	0	0	0	102
06:00	1	289	47	3	3	0	0	0	0	1	0	0	0	344
07:00	5	705	70	12	11	3	0	1	1	0	0	0	0	808
08:00	5	809	59	5	15	1	0	3	1	0	0	0	0	898
09:00	2	504	70	4	9	1	0	1	1	0	0	0	0	592
10:00	0	321	45	4	10	3	0	2	2	0	0	0	0	387
11:00	1	345	50	4	13	1	0	2	1	0	0	0	0	417
12 PM	3	355	58	3	10	0	0	2	3	0	0	0	0	434
13:00	2	357	31	2	12	2	0	1	2	0	0	0	0	409
14:00	3	373	45	4	8	6	0	3	1	0	0	0	0	443
15:00	0	563	92	6	12	1	0	2	0	0	0	0	0	676
16:00	5	537	60	5	7	0	0	0	0	0	0	0	0	614
17:00	1	465	37	1	1	1	0	1	0	0	0	0	0	507
18:00	2	378	27	2	2	1	0	0	0	0	0	0	0	412
19:00	1	241	33	1	2	0	0	2	0	0	0	0	0	280
20:00	1	150	13	0	2	0	0	0	0	0	0	0	0	166
21:00	0	107	11	0	0	0	0	0	0	0	0	0	0	118
22:00	0	72	9	1	0	0	0	0	2	0	0	0	0	84
23:00	0	54	4	0	0	0	0	0	0	0	0	0	0	58
Total	32	6755	785	59	125	21	0	20	21	1	0	0	0	7819
Percent	0.4%	86.4%	10.0%	0.8%	1.6%	0.3%	0.0%	0.3%	0.3%	0.0%	0.0%	0.0%	0.0%	
AM Peak	07:00	08:00	07:00	07:00	08:00	07:00		08:00	05:00	06:00				08:00
Vol.	5	809	70	12	15	3		3	3	1				898
PM Peak	16:00	15:00	15:00	15:00	13:00	14:00		14:00	12:00					15:00
Vol.	5	563	92	6	12	6		3	3					676



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Massachusetts Avenue (Route 2A)
east of Marrett Street
City, State: Lexington, MA
Client: Toole Design/ C. Fink

133213 A Class
Site Code: TBA

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
03/01/1														
3	0	10	1	1	1	0	0	0	0	0	0	0	0	13
01:00	0	11	4	0	0	0	0	0	0	0	0	0	0	15
02:00	0	5	3	0	1	0	0	0	3	0	0	0	0	12
03:00	0	4	3	0	0	0	0	0	1	0	0	0	0	8
04:00	0	19	8	0	2	0	0	0	2	0	0	0	0	31
05:00	0	75	12	1	1	0	0	0	0	1	0	0	0	90
06:00	0	281	45	3	8	1	0	0	0	0	0	0	0	338
07:00	2	643	74	10	2	2	0	2	2	0	0	0	0	737
08:00	3	732	61	6	9	3	0	1	1	2	0	0	0	818
09:00	3	493	44	5	9	0	0	1	0	0	0	0	0	555
10:00	1	338	62	4	10	3	0	0	2	0	0	0	0	420
11:00	0	391	59	5	9	1	0	3	1	0	0	0	0	469
12 PM	0	365	56	6	4	0	0	2	1	0	0	0	0	434
13:00	0	314	56	3	6	2	0	2	2	0	0	0	0	385
14:00	2	438	62	4	4	1	0	0	1	0	0	0	0	512
15:00	1	542	74	4	5	0	0	1	1	0	0	0	0	628
16:00	6	507	48	5	3	0	0	2	0	0	0	0	0	571
17:00	4	450	32	1	6	0	1	0	0	0	0	0	0	494
18:00	1	403	25	2	1	1	0	0	0	0	0	0	0	433
19:00	1	234	17	1	2	1	0	1	0	0	0	0	0	257
20:00	1	111	12	0	2	0	0	0	0	0	0	0	0	126
21:00	0	115	9	1	0	0	0	1	0	0	0	0	0	126
22:00	0	72	6	1	0	0	0	0	0	0	0	0	0	79
23:00	0	70	4	0	0	0	0	0	0	0	0	0	0	74
Total	25	6623	777	63	85	15	1	16	17	3	0	0	0	7625
Percent	0.3%	86.9%	10.2%	0.8%	1.1%	0.2%	0.0%	0.2%	0.2%	0.0%	0.0%	0.0%	0.0%	
AM Peak	08:00	08:00	07:00	07:00	10:00	08:00		11:00	02:00	08:00				08:00
Vol.	3	732	74	10	10	3		3	3	2				818
PM Peak	16:00	15:00	15:00	12:00	13:00	13:00	17:00	12:00	13:00					15:00
Vol.	6	542	74	6	6	2	1	2	2					628



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Massachusetts Avenue (Route 2A)
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133213 A Class
Site Code: TBA

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
03/02/1														
3	0	28	3	0	2	0	0	0	0	0	0	0	0	33
01:00	0	8	1	0	0	0	0	0	0	0	0	0	0	9
02:00	0	7	0	0	2	0	0	0	0	0	0	0	0	9
03:00	0	2	3	0	0	0	0	0	0	0	0	0	0	5
04:00	0	10	2	0	2	0	0	1	1	0	0	0	0	16
05:00	0	25	4	0	1	0	0	0	0	0	0	0	0	30
06:00	0	70	15	0	3	1	0	0	1	0	0	0	0	90
07:00	0	140	18	1	1	0	0	0	1	0	0	0	0	161
08:00	1	212	20	2	5	1	0	0	1	1	0	0	0	243
09:00	1	277	30	2	4	0	0	0	2	0	0	0	0	316
10:00	4	356	29	3	3	0	0	2	3	0	0	0	0	400
11:00	5	405	31	2	3	0	0	0	3	0	0	0	0	449
12 PM	3	381	32	2	6	0	0	0	0	0	0	0	0	424
13:00	0	401	28	2	2	0	0	0	0	0	0	0	0	433
14:00	6	389	49	3	4	0	0	1	0	0	0	0	0	452
15:00	2	401	25	3	5	0	0	1	0	0	0	0	0	437
16:00	0	380	24	4	1	0	0	0	0	0	0	0	0	409
17:00	0	321	28	3	2	1	0	0	0	0	0	0	0	355
18:00	1	235	20	2	2	0	0	0	0	1	0	0	0	261
19:00	0	153	19	2	1	0	0	0	0	1	0	0	0	176
20:00	0	84	8	1	0	0	0	0	0	0	0	0	0	93
21:00	0	112	4	0	0	0	0	0	0	0	0	0	0	116
22:00	0	74	11	0	0	0	0	0	0	0	0	0	0	85
23:00	0	76	4	0	0	0	0	0	0	0	0	0	0	80
Total	23	4547	408	32	49	3	0	5	12	3	0	0	0	5082
Percent	0.5%	89.5%	8.0%	0.6%	1.0%	0.1%	0.0%	0.1%	0.2%	0.1%	0.0%	0.0%	0.0%	
AM Peak	11:00	11:00	11:00	10:00	08:00	06:00		10:00	10:00	08:00				11:00
Vol.	5	405	31	3	5	1		2	3	1				449
PM Peak	14:00	13:00	14:00	16:00	12:00	17:00		14:00		18:00				14:00
Vol.	6	401	49	4	6	1		1		1				452



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EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
03/03/1														
3	0	26	1	0	0	0	0	0	0	0	0	0	0	27
01:00	1	15	1	0	1	0	0	0	0	0	0	0	0	18
02:00	0	4	2	0	0	0	0	0	0	0	0	0	0	6
03:00	0	4	0	0	0	0	0	0	0	0	0	0	0	4
04:00	0	5	1	0	0	0	0	0	0	0	0	0	0	6
05:00	0	12	2	0	0	0	0	0	1	0	0	0	0	15
06:00	0	44	8	0	0	0	0	0	1	0	0	0	0	53
07:00	0	74	14	0	1	0	0	0	1	0	0	0	0	90
08:00	0	181	9	1	2	0	0	0	1	0	0	0	0	194
09:00	0	222	20	0	1	0	0	0	0	0	0	0	0	243
10:00	1	307	26	0	1	0	0	1	1	0	0	0	0	337
11:00	3	300	39	0	1	1	0	0	0	0	0	0	0	344
12 PM	0	355	37	1	5	0	0	0	0	0	0	0	0	398
13:00	1	368	28	0	2	0	0	0	0	0	0	0	0	399
14:00	1	351	37	0	4	0	0	0	0	0	0	0	0	393
15:00	4	380	34	1	3	0	0	1	1	0	0	0	0	424
16:00	1	353	23	0	3	0	0	0	0	0	0	0	0	380
17:00	0	245	29	0	2	0	0	0	0	0	0	0	0	276
18:00	1	179	21	0	1	0	0	0	0	0	0	0	0	202
19:00	0	132	19	1	1	0	0	0	0	0	0	0	0	153
20:00	0	83	8	0	0	1	0	0	0	0	0	0	0	92
21:00	0	63	8	0	0	0	0	0	0	0	0	0	0	71
22:00	0	38	3	0	0	0	0	0	0	0	0	0	0	41
23:00	0	29	2	0	0	0	0	0	0	0	0	0	0	31
Total	13	3770	372	4	28	2	0	2	6	0	0	0	0	4197
Percent	0.3%	89.8%	8.9%	0.1%	0.7%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	
AM Peak	11:00	10:00	11:00	08:00	08:00	11:00		10:00	05:00					11:00
Vol.	3	307	39	1	2	1		1	1					344
PM Peak	15:00	15:00	12:00	12:00	12:00	20:00		15:00	15:00					15:00
Vol.	4	380	37	1	5	1		1	1					424



PRECISION
D A T A
INDUSTRIES, LLC

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133213 A Class
Site Code: TBA

Massachusetts Avenue (Route 2A)
east of Marrett Street
City, State: Lexington, MA
Client: Toole Design/ C. Fink

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
03/04/1														
3	0	5	1	0	1	0	0	0	0	0	0	0	0	7
01:00	0	6	1	0	0	0	0	0	0	0	0	0	0	7
02:00	0	3	0	1	0	0	0	0	1	0	0	0	0	5
03:00	0	3	3	1	0	0	0	0	1	0	0	0	0	8
04:00	0	15	11	0	3	0	0	0	1	1	0	0	0	31
05:00	0	84	17	0	1	0	0	0	2	0	0	0	0	104
06:00	1	309	46	3	1	2	0	0	1	0	0	0	0	363
07:00	6	673	64	13	9	2	0	3	1	0	0	0	1	772
08:00	3	812	51	6	12	5	1	2	2	1	0	0	0	895
09:00	0	454	54	5	6	5	0	2	1	0	0	0	0	527
10:00	0	310	45	3	7	2	0	1	4	0	0	0	0	372
11:00	0	286	61	4	13	2	0	2	1	0	0	0	0	369
12 PM	1	312	32	3	5	2	0	0	4	1	0	0	0	360
13:00	2	288	32	2	7	4	1	2	0	1	0	0	0	339
14:00	1	338	68	3	4	5	0	3	1	0	0	0	0	423
15:00	3	530	80	6	9	2	0	0	1	0	0	0	0	631
16:00	1	482	44	6	6	0	0	0	0	0	0	0	0	539
17:00	4	481	41	3	10	0	0	1	1	0	0	0	0	541
18:00	2	362	26	1	2	0	0	0	0	0	0	0	0	393
19:00	0	226	17	1	1	0	0	0	0	0	0	0	0	245
20:00	0	123	17	0	1	0	0	0	0	0	0	0	0	141
21:00	0	91	7	0	0	0	0	0	1	0	0	0	0	99
22:00	0	52	5	1	0	0	0	0	0	0	0	0	0	58
23:00	0	31	12	0	0	0	0	1	0	0	0	0	0	44
Total	24	6276	735	62	98	31	2	17	23	4	0	0	1	7273
Percent	0.3%	86.3%	10.1%	0.9%	1.3%	0.4%	0.0%	0.2%	0.3%	0.1%	0.0%	0.0%	0.0%	
AM Peak	07:00	08:00	07:00	07:00	11:00	08:00	08:00	07:00	10:00	04:00			07:00	08:00
Vol.	6	812	64	13	13	5	1	3	4	1			1	895
PM Peak	17:00	15:00	15:00	15:00	17:00	14:00	13:00	14:00	12:00	12:00				15:00
Vol.	4	530	80	6	10	5	1	3	4	1				631
Total		40830	4624	352	554	112	4	96	128	16	1	0	1	46894



PRECISION
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133213 A Speed
Site Code: TBA

Massachusetts Avenue (Route 2A)
east of Marrett Street
City, State: Lexington, MA
Client: Toole Design/ C. Fink

WB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
02/26/1																
3	0	0	0	0	1	6	6	0	0	0	0	0	0	13	42	39
01:00	0	0	0	0	3	3	3	0	0	0	0	0	0	9	40	37
02:00	0	0	0	1	1	3	4	0	0	0	0	0	0	9	41	38
03:00	0	0	0	0	0	9	2	2	0	0	0	0	0	13	39	39
04:00	0	0	0	0	2	3	11	3	1	0	0	0	0	20	45	41
05:00	0	0	0	1	16	64	63	7	0	0	0	0	0	151	42	39
06:00	0	0	0	8	64	227	172	10	1	0	0	0	0	482	42	38
07:00	0	0	0	6	116	468	195	13	2	0	0	0	0	800	41	38
08:00	1	1	1	8	128	376	99	11	2	0	0	0	0	627	40	37
09:00	0	0	0	3	100	290	159	21	1	0	0	0	0	574	41	38
10:00	0	0	0	9	50	168	114	10	1	0	0	0	0	352	42	38
11:00	0	0	0	4	66	207	111	14	0	0	0	0	0	402	41	38
12 PM	0	0	0	15	93	262	101	8	0	0	0	0	0	479	40	37
13:00	0	0	0	1	71	243	140	14	1	0	0	0	0	470	42	38
14:00	0	0	1	12	68	264	159	20	1	0	0	0	0	525	42	38
15:00	0	0	0	1	80	310	180	14	1	0	0	0	0	586	41	38
16:00	0	0	0	9	109	402	212	8	0	0	0	0	0	740	41	38
17:00	0	0	2	22	251	454	121	5	0	0	0	0	0	855	39	36
18:00	0	0	0	20	207	363	78	12	1	0	0	0	0	681	39	36
19:00	0	0	0	2	60	198	97	9	0	0	0	0	0	366	41	38
20:00	0	0	0	2	41	122	68	12	1	0	0	0	0	246	42	38
21:00	0	0	0	1	14	91	71	9	0	0	0	0	0	186	42	39
22:00	0	0	0	0	12	49	33	9	0	0	0	0	0	103	43	39
23:00	0	0	0	0	4	23	16	3	1	0	0	0	0	47	43	39

%	0.0%	0.0%	0.0%	1.4%	17.8%	52.7%	25.4%	2.4%	0.2%	0.0%	0.0%	0.0%	0.0%															
AM Peak	08:00	08:00	08:00	06:00	08:00	07:00	07:00	09:00	07:00																	07:00		
Vol.	1	1	1	8	128	468	195	21	2																	800		
Midday Peak				14:00	12:00	12:00	14:00	14:00	14:00	13:00																14:00		
Vol.				1	15	93	264	159	20	1																525		
PM Peak				17:00	17:00	17:00	17:00	16:00	15:00	15:00																17:00		
Vol.				2	22	251	454	212	14	1																855		
% ile				15th Percentile :		32 MPH																						
				50th Percentile :		36 MPH																						
				85th Percentile :		41 MPH																						
				95th Percentile :		44 MPH																						

Stats

10 MPH Pace Speed : 33-42 MPH

Number in Pace : 6556

Percent in Pace : 75.0%

Number of Vehicles > 40 MPH : 2095

Percent of Vehicles > 40 MPH : 24.0%

Mean Speed(Average) : 37 MPH



PRECISION
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Massachusetts Avenue (Route 2A)
east of Marrett Street
City, State: Lexington, MA
Client: Toole Design/ C. Fink

133213 A Speed
Site Code: TBA

WB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
02/27/1																
3	0	0	0	0	2	7	7	0	0	0	0	0	0	16	43	39
01:00	0	0	0	0	3	2	2	0	1	0	0	0	0	8	33	38
02:00	0	0	0	0	0	2	2	2	0	0	0	0	0	6	*	42
03:00	0	0	0	0	3	6	3	3	0	0	0	0	0	15	44	39
04:00	0	0	0	1	3	6	10	2	0	0	0	0	0	22	42	39
05:00	0	0	0	2	23	67	37	11	0	0	0	0	0	140	42	38
06:00	0	0	0	5	55	247	137	11	0	0	0	0	0	455	41	38
07:00	2	0	0	8	191	413	102	10	1	0	0	0	0	727	39	36
08:00	0	0	5	25	160	342	70	5	0	0	0	0	1	608	39	36
09:00	0	0	4	27	134	290	87	8	3	0	0	0	0	553	40	36
10:00	0	0	0	10	62	197	79	9	0	1	0	0	0	358	41	37
11:00	0	0	0	6	74	165	105	8	3	0	0	0	0	361	41	38
12 PM	0	0	4	6	86	201	94	6	0	0	0	0	1	398	41	37
13:00	0	0	0	17	71	229	93	11	0	0	0	0	0	421	41	37
14:00	0	0	0	17	105	224	105	7	0	0	0	0	0	458	41	37
15:00	101	32	34	35	44	57	6	1	0	0	0	0	0	310	34	19
16:00	39	33	27	18	129	349	109	8	0	0	0	0	0	712	39	32
17:00	0	0	20	121	321	320	73	4	0	0	0	0	0	859	38	34
18:00	0	0	19	128	356	218	23	4	0	0	0	0	0	748	37	33
19:00	0	0	0	8	84	173	49	3	1	0	0	0	0	318	39	36
20:00	0	0	0	4	74	143	46	2	0	0	0	0	0	269	40	36
21:00	0	0	1	6	52	102	35	4	1	0	0	0	0	201	40	36
22:00	0	0	0	2	8	38	22	6	0	0	0	0	0	76	42	38
23:00	0	0	0	0	8	12	9	2	0	0	0	0	0	31	42	38

%	1.8%	0.8%	1.4%	5.5%	25.4%	47.2%	16.2%	1.6%	0.1%	0.0%	0.0%	0.0%	0.0%			
AM Peak Vol.	07:00		08:00	09:00	07:00	07:00	06:00	05:00	09:00				08:00	07:00		
	2		5	27	191	413	137	11	3				1	727		
Midday Peak Vol.			12:00	13:00	14:00	13:00	11:00	13:00	11:00				12:00	14:00		
			4	17	105	229	105	11	3				1	458		
PM Peak Vol.	15:00	16:00	15:00	18:00	18:00	16:00	16:00	16:00	19:00					17:00		
	101	33	34	128	356	349	109	8	1					859		
% ile			15th Percentile :			29 MPH										
			50th Percentile :			35 MPH										
			85th Percentile :			40 MPH										
			95th Percentile :			43 MPH										

Stats 10 MPH Pace Speed : 32-41 MPH
 Number in Pace : 5471
 Percent in Pace : 67.8%
 Number of Vehicles > 40 MPH : 1262
 Percent of Vehicles > 40 MPH : 15.6%
 Mean Speed(Average) : 35 MPH



PRECISION
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Massachusetts Avenue (Route 2A)
east of Marrett Street
City, State: Lexington, MA
Client: Toole Design/ C. Fink

133213 A Speed
Site Code: TBA

WB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
02/28/1																												
3	0	0	0	0	0	0	0	1	13	7	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	43	39
01:00	0	0	0	0	0	0	0	1	7	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	13	41	40
02:00	0	0	0	0	0	0	0	1	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	41	39
03:00	0	0	0	0	0	0	0	1	2	5	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	10	43	42
04:00	0	0	0	0	0	0	0	3	9	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	42	39
05:00	0	0	1	1	21	72	56	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	159	42	38
06:00	0	0	0	8	53	258	167	22	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	510	42	38
07:00	0	0	0	15	131	418	186	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	763	41	37
08:00	1	0	0	12	155	355	132	14	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	670	40	37
09:00	0	0	1	8	81	269	141	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	515	41	38
10:00	0	4	0	7	40	163	120	9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	344	42	38
11:00	3	11	9	7	55	163	124	13	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	386	42	36
12 PM	0	0	9	8	98	260	112	7	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	496	40	37
13:00	0	0	1	5	62	204	169	20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	462	42	38
14:00	0	0	0	16	103	266	154	11	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	551	41	37
15:00	1	0	0	4	101	356	159	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	637	41	38
16:00	0	0	3	13	131	494	191	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	838	40	37
17:00	0	0	4	19	196	500	145	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	871	40	37
18:00	0	1	6	21	176	329	99	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	636	39	36
19:00	0	0	0	2	56	233	93	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	396	41	38
20:00	1	0	0	2	26	134	100	10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	275	42	39
21:00	0	0	0	2	30	92	65	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	200	42	38
22:00	0	0	0	0	13	47	47	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	113	42	39
23:00	0	0	0	0	6	24	20	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	56	43	39

%	0.1%	0.2%	0.4%	1.7%	17.2%	52.2%	25.8%	2.4%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AM Peak Vol.	08:00		05:00	07:00	08:00	07:00	07:00	06:00	01:00		06:00				07:00	
	1		1	15	155	418	186	22	1		1				763	
Midday Peak Vol.	11:00	11:00	11:00	14:00	14:00	14:00	13:00	13:00	12:00	11:00					14:00	
	3	11	9	16	103	266	169	20	1	1					551	
PM Peak Vol.	15:00	18:00	18:00	18:00	17:00	17:00	16:00	15:00	20:00						17:00	
	1	1	6	21	196	500	191	16	2						871	

% ile
15th Percentile : 32 MPH
50th Percentile : 36 MPH
85th Percentile : 41 MPH
95th Percentile : 44 MPH

Stats
10 MPH Pace Speed : 33-42 MPH
Number in Pace : 6665
Percent in Pace : 74.4%
Number of Vehicles > 40 MPH : 2168
Percent of Vehicles > 40 MPH : 24.2%
Mean Speed(Average) : 37 MPH



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133213 A Speed
Site Code: TBA

WB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
03/01/1																
3	0	0	0	0	2	8	9	5	0	0	0	0	0	24	45	41
01:00	0	0	0	0	3	1	5	1	0	0	0	0	0	10	43	39
02:00	0	0	0	0	0	3	5	2	0	0	0	0	0	10	44	42
03:00	0	0	1	0	1	2	1	4	0	0	0	0	0	9	47	40
04:00	0	0	0	0	4	12	7	2	0	1	0	0	0	26	42	39
05:00	0	0	0	1	10	55	52	22	1	0	0	0	0	141	44	40
06:00	0	0	0	0	44	192	186	37	3	0	0	0	0	462	43	39
07:00	1	1	0	21	121	392	194	19	1	1	0	0	0	751	41	37
08:00	0	0	2	5	85	328	174	15	0	0	0	0	0	609	41	38
09:00	0	0	0	8	103	250	120	8	0	0	0	0	0	489	41	37
10:00	0	0	0	4	59	201	136	14	1	0	0	0	0	415	42	38
11:00	0	0	2	2	79	204	104	14	1	0	0	0	0	406	41	38
12 PM	0	0	0	3	76	221	148	22	0	0	0	0	0	470	42	38
13:00	0	0	0	2	53	259	145	17	1	0	0	0	0	477	42	38
14:00	0	0	3	9	93	278	159	14	0	0	0	0	0	556	41	38
15:00	0	0	0	4	118	367	156	7	0	1	0	0	0	653	41	37
16:00	0	0	0	3	136	390	191	17	0	0	0	0	0	737	41	38
17:00	1	1	1	14	166	443	141	11	1	0	0	0	0	779	40	37
18:00	0	0	0	10	159	331	109	6	0	0	0	0	0	615	40	37
19:00	0	0	0	1	56	160	97	13	0	0	0	0	0	327	42	38
20:00	0	0	0	3	32	116	65	4	1	0	0	0	0	221	41	38
21:00	0	1	0	2	29	101	56	8	1	0	0	0	0	198	42	38
22:00	0	0	0	0	23	108	65	7	1	0	0	0	0	204	42	38
23:00	0	0	0	0	8	37	28	3	1	0	0	0	0	77	42	39

%	0.0%	0.0%	0.1%	1.1%	16.8%	51.5%	27.2%	3.1%	0.2%	0.0%	0.0%	0.0%	0.0%			
AM Peak	07:00	07:00	08:00	07:00	07:00	07:00	07:00	06:00	06:00	04:00				07:00		
Vol.	1	1	2	21	121	392	194	37	3	1				751		
Midday Peak			14:00	14:00	14:00	14:00	14:00	12:00	11:00					14:00		
Vol.			3	9	93	278	159	22	1					556		
PM Peak	17:00	17:00	17:00	17:00	17:00	17:00	16:00	16:00	17:00	15:00				17:00		
Vol.	1	1	1	14	166	443	191	17	1	1				779		
% ile			15th Percentile :			32 MPH										
			50th Percentile :			37 MPH										
			85th Percentile :			41 MPH										
			95th Percentile :			44 MPH										

Stats 10 MPH Pace Speed : 33-42 MPH
 Number in Pace : 6453
 Percent in Pace : 74.5%
 Number of Vehicles > 40 MPH : 2254
 Percent of Vehicles > 40 MPH : 26.0%
 Mean Speed(Average) : 38 MPH



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

Massachusetts Avenue (Route 2A)
east of Marrett Street
City, State: Lexington, MA
Client: Toole Design/ C. Fink

133213 A Speed
Site Code: TBA

WB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
03/02/1																
3	0	0	0	0	2	16	14	1	0	0	0	0	0	33	42	39
01:00	0	0	0	2	1	13	4	2	0	0	0	0	0	22	42	38
02:00	0	0	0	0	0	3	2	1	0	0	0	0	0	6	38	40
03:00	0	0	1	0	1	3	4	3	0	0	0	0	0	12	45	40
04:00	0	0	0	0	1	6	2	1	0	0	0	0	0	10	39	39
05:00	0	0	0	0	3	13	12	7	1	0	0	0	0	36	45	41
06:00	0	0	0	0	8	35	65	20	0	1	0	0	0	129	44	41
07:00	0	0	0	3	12	92	95	19	3	0	0	0	0	224	43	40
08:00	0	0	0	0	15	102	118	30	2	0	0	0	0	267	44	40
09:00	0	0	0	3	33	148	105	15	1	0	0	0	0	305	42	39
10:00	0	0	0	2	34	187	110	11	0	0	0	0	0	344	42	38
11:00	0	0	2	5	69	198	128	13	0	0	0	0	0	415	42	38
12 PM	0	1	0	8	63	276	110	12	0	0	0	0	0	470	41	38
13:00	0	0	0	3	75	223	159	12	0	0	0	0	0	472	42	38
14:00	0	0	0	8	97	203	155	16	0	0	0	0	0	479	42	38
15:00	0	0	0	7	61	251	136	20	0	0	0	0	0	475	42	38
16:00	0	0	0	7	60	209	116	19	0	0	0	0	0	411	42	38
17:00	0	0	0	2	31	183	131	15	1	0	0	0	0	363	42	39
18:00	0	0	0	6	70	186	73	10	0	0	0	0	0	345	41	37
19:00	0	0	0	3	32	110	65	7	0	0	0	0	0	217	42	38
20:00	0	0	0	3	24	82	56	3	2	0	0	0	0	170	42	38
21:00	0	0	1	2	23	112	75	1	0	0	0	0	0	214	41	38
22:00	0	0	2	0	20	70	42	3	0	0	0	0	0	137	41	38
23:00	0	0	0	1	10	62	32	3	0	0	0	0	0	108	41	38

%	0.0%	0.0%	0.1%	1.1%	13.2%	49.1%	31.9%	4.3%	0.2%	0.0%	0.0%	0.0%	0.0%															
AM Peak Vol.			03:00	07:00	09:00	09:00	08:00	08:00	07:00	06:00																09:00		
			1	3	33	148	118	30	3	1																305		
Midday Peak Vol.		12:00	11:00	12:00	14:00	12:00	13:00	14:00																		14:00		
		1	2	8	97	276	159	16																		479		
PM Peak Vol.			22:00	15:00	18:00	15:00	15:00	15:00	20:00																	15:00		
			2	7	70	251	136	20	2																	475		
% ile			15th Percentile :			33 MPH																						
			50th Percentile :			37 MPH																						
			85th Percentile :			42 MPH																						
			95th Percentile :			44 MPH																						

Stats
10 MPH Pace Speed : 34-43 MPH
Number in Pace : 4235
Percent in Pace : 74.8%
Number of Vehicles > 40 MPH : 1741
Percent of Vehicles > 40 MPH : 30.7%
Mean Speed(Average) : 38 MPH



PRECISION
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Massachusetts Avenue (Route 2A)
east of Marrett Street
City, State: Lexington, MA
Client: Toole Design/ C. Fink

133213 A Speed
Site Code: TBA

WB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
03/03/1																												
3	0	0	0	0	0	4	23	11	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	44	43	39
01:00	0	0	0	0	0	1	5	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	42	40
02:00	0	0	0	0	0	1	2	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	43	41
03:00	0	0	0	0	0	0	1	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	44	43
04:00	0	0	1	0	2	3	4	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	11	41	38
05:00	0	0	0	1	1	10	11	4	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	28	44	41
06:00	0	0	0	0	1	25	39	11	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	78	44	41
07:00	0	0	0	2	5	66	65	17	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	158	43	40
08:00	0	0	0	0	10	57	76	16	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	160	44	40
09:00	0	0	1	4	29	83	88	24	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	231	43	39
10:00	0	0	1	4	61	179	85	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	340	41	37
11:00	1	0	0	2	40	147	116	18	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	325	42	39
12 PM	0	0	1	6	61	223	138	18	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	448	42	38
13:00	0	0	0	6	50	230	136	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	437	42	38
14:00	0	0	0	6	62	217	122	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	420	42	38
15:00	0	0	0	13	67	188	125	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	412	42	38
16:00	0	0	1	3	63	220	117	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	418	41	38
17:00	0	0	0	4	35	161	106	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	315	42	38
18:00	0	0	2	0	35	159	73	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	273	41	38
19:00	0	0	2	2	24	132	48	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	214	41	38
20:00	1	0	0	4	26	84	42	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	159	41	37
21:00	0	0	0	0	17	54	23	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	99	41	38
22:00	0	0	0	0	6	23	16	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	48	42	39
23:00	0	0	0	0	5	7	9	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	43	39

%	0.0%	0.0%	0.2%	1.2%	13.0%	49.2%	31.4%	4.7%	0.2%	0.1%	0.0%	0.0%	0.0%															
AM Peak Vol.			04:00	09:00	09:00	09:00	09:00	09:00	06:00	07:00																09:00		
			1	4	29	83	88	24	2	2																231		
Midday Peak Vol.	11:00		12:00	12:00	14:00	13:00	12:00	11:00	11:00																	12:00		
	1		1	6	62	230	138	18	1																	448		
PM Peak Vol.	20:00		18:00	15:00	15:00	16:00	15:00	15:00	19:00																	16:00		
	1		2	13	67	220	125	19	1																	418		
% ile			15th Percentile :			33 MPH																						
			50th Percentile :			37 MPH																						
			85th Percentile :			42 MPH																						
			95th Percentile :			45 MPH																						

Stats
10 MPH Pace Speed : 34-43 MPH
Number in Pace : 3477
Percent in Pace : 74.4%
Number of Vehicles > 40 MPH : 1440
Percent of Vehicles > 40 MPH : 30.8%
Mean Speed(Average) : 38 MPH



PRECISION
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Client: Toole Design/ C. Fink

133213 A Speed
Site Code: TBA

WB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
03/04/1																												
3	0	0	0	0	0	0	0	2	6	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	43	39
01:00	0	0	0	0	0	0	0	1	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	41	39
02:00	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	*	37
03:00	0	0	0	0	0	0	0	3	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	7	32	39
04:00	0	0	0	0	0	0	0	0	6	11	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	45	42
05:00	0	0	0	0	3	12	61	71	26	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	175	44	40
06:00	0	0	0	0	0	49	228	193	32	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	504	43	39
07:00	1	0	0	0	8	92	373	203	21	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	702	42	38
08:00	0	0	0	0	11	109	371	137	9	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	638	40	37
09:00	0	0	0	0	3	32	212	163	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	426	42	39
10:00	0	0	0	0	2	50	172	107	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	344	42	38
11:00	0	1	1	6	80	183	105	12	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	389	41	37
12 PM	0	0	0	9	96	216	100	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	435	41	37
13:00	0	0	0	2	81	251	131	9	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	475	41	38
14:00	0	0	1	3	104	274	134	15	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	532	41	38
15:00	1	0	0	5	89	315	164	13	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	588	41	38
16:00	0	0	0	9	135	417	162	13	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	738	41	37
17:00	0	4	12	51	210	455	116	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	854	39	36
18:00	0	0	5	15	235	313	53	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	625	38	35
19:00	0	0	1	7	75	173	73	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	336	41	37
20:00	0	0	0	0	23	106	51	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	195	42	38
21:00	0	0	0	0	33	90	38	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	171	41	38
22:00	0	0	0	0	11	41	21	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	82	43	39
23:00	0	0	0	1	1	1	19	18	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	43	42	39

%	0.0%	0.1%	0.3%	1.6%	18.4%	51.6%	24.8%	3.1%	0.2%	0.0%	0.0%	0.0%	0.0%															
AM Peak Vol.	07:00				08:00	08:00	07:00	07:00	06:00	07:00	08:00															07:00		
	1				11	109	373	203	32	4	1															702		
Midday Peak Vol.		11:00	11:00	12:00	14:00	14:00	14:00	14:00	14:00	11:00	13:00															14:00		
		1	1	9	104	274	134	15	1	1																532		
PM Peak Vol.	15:00	17:00	17:00	17:00	18:00	17:00	15:00	20:00	16:00																	17:00		
	1	4	12	51	235	455	164	15	2																	854		
% ile				15th Percentile :		32 MPH																						
				50th Percentile :		36 MPH																						
				85th Percentile :		41 MPH																						
				95th Percentile :		44 MPH																						

Stats
10 MPH Pace Speed : 33-42 MPH
Number in Pace : 6129
Percent in Pace : 73.8%
Number of Vehicles > 40 MPH : 2008
Percent of Vehicles > 40 MPH : 24.2%
Mean Speed(Average) : 37 MPH



PRECISION
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133213 A Speed
Site Code: TBA

EB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
02/26/1																
3	0	0	0	0	1	3	3	6	1	0	0	0	0	14	47	43
01:00	0	0	0	0	0	0	2	1	2	0	0	0	0	5	*	47
02:00	0	0	0	0	0	0	3	1	1	1	0	0	0	6	42	47
03:00	0	0	0	0	0	2	2	1	2	0	0	0	0	7	*	44
04:00	0	0	0	0	2	6	12	8	1	1	0	0	0	30	46	43
05:00	0	0	0	3	6	22	40	28	6	0	0	0	0	105	47	42
06:00	0	0	0	2	13	114	178	64	7	0	0	0	0	378	45	41
07:00	0	0	2	6	58	320	290	62	1	0	0	0	0	739	43	39
08:00	13	17	43	73	148	438	172	15	1	0	0	0	0	920	40	35
09:00	0	0	0	1	90	303	212	18	0	0	0	0	0	624	42	38
10:00	0	0	1	19	35	168	167	34	4	0	0	0	0	428	43	39
11:00	0	0	0	0	33	173	171	44	3	0	0	0	0	424	43	40
12 PM	0	0	0	5	19	133	191	50	3	0	0	0	0	401	44	40
13:00	0	2	0	13	22	138	183	52	2	0	0	0	0	412	44	40
14:00	0	0	0	0	34	147	233	55	0	0	0	0	0	469	44	40
15:00	0	0	0	3	37	197	322	85	3	0	0	0	0	647	44	41
16:00	0	0	0	0	9	203	287	62	4	0	0	0	0	565	44	41
17:00	0	0	1	0	24	214	256	63	0	0	1	0	1	560	44	40
18:00	0	0	0	1	34	155	166	57	3	0	0	0	0	416	44	40
19:00	0	0	0	0	21	83	115	37	4	0	0	0	0	260	44	40
20:00	0	0	0	0	13	37	90	29	3	0	0	0	0	172	45	41
21:00	0	0	0	0	1	23	44	15	3	1	0	0	0	87	46	42
22:00	0	0	0	0	1	14	33	16	2	0	0	0	0	66	46	42
23:00	0	0	0	0	1	17	19	10	0	0	0	0	0	47	45	41

%	0.2%	0.2%	0.6%	1.6%	7.7%	37.4%	41.0%	10.4%	0.7%	0.0%	0.0%	0.0%	0.0%			
AM Peak Vol.	08:00	08:00	08:00	08:00	08:00	08:00	07:00	06:00	06:00	02:00				08:00		
	13	17	43	73	148	438	290	64	7	1				920		
Midday Peak Vol.		13:00		13:00	14:00	11:00	14:00	14:00	11:00					14:00		
		2		13	34	173	233	55	3					469		
PM Peak Vol.			17:00	15:00	15:00	17:00	15:00	15:00	16:00	21:00	17:00		17:00	15:00		
			1	3	37	214	322	85	4	1	1		1	647		
% ile			15th Percentile :			34 MPH										
			50th Percentile :			39 MPH										
			85th Percentile :			43 MPH										
			95th Percentile :			46 MPH										

Stats

10 MPH Pace Speed : 35-44 MPH

Number in Pace : 5525

Percent in Pace : 71.0%

Number of Vehicles > 40 MPH : 3406

Percent of Vehicles > 40 MPH : 43.8%

Mean Speed(Average) : 39 MPH



PRECISION
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Client: Toole Design/ C. Fink

133213 A Speed
Site Code: TBA

EB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
02/27/1																
3	0	0	0	0	1	0	8	11	13	4	1	0	0	38	54	49
01:00	0	0	0	0	0	1	6	5	0	0	0	0	0	12	47	44
02:00	0	0	0	0	2	1	6	1	0	0	0	0	0	10	43	40
03:00	0	0	0	0	0	3	7	1	0	1	0	0	0	12	43	42
04:00	0	0	0	0	1	11	11	4	0	0	0	0	0	27	44	40
05:00	0	0	0	0	4	32	36	19	2	0	0	0	0	93	45	41
06:00	0	0	1	2	12	129	164	37	2	0	0	0	0	347	44	40
07:00	1	4	10	28	106	404	213	22	0	0	0	0	0	788	41	37
08:00	9	15	40	49	201	446	151	23	1	0	0	0	0	935	40	35
09:00	0	2	1	12	47	289	238	25	0	0	0	0	0	614	42	39
10:00	0	0	0	14	25	114	160	27	2	0	0	0	0	342	43	39
11:00	0	0	0	0	14	156	164	36	2	0	0	0	0	372	43	40
12 PM	0	1	0	0	14	148	167	27	1	0	0	0	0	358	43	40
13:00	0	0	0	0	13	113	162	29	3	0	0	0	0	320	43	40
14:00	1	0	0	1	46	217	145	19	3	0	0	0	0	432	42	39
15:00	3	13	39	38	167	142	37	4	0	0	0	0	0	443	38	32
16:00	1	0	22	6	60	206	189	30	0	0	0	0	0	514	42	38
17:00	1	0	0	9	87	227	135	24	4	0	0	0	0	487	42	38
18:00	0	0	4	23	99	173	76	9	0	0	0	0	0	384	40	36
19:00	0	0	0	4	35	99	80	19	3	0	0	0	0	240	43	39
20:00	0	1	0	1	10	81	45	18	0	0	0	0	0	156	43	39
21:00	0	0	0	0	5	31	46	11	1	0	0	0	0	94	44	41
22:00	0	0	0	1	3	19	27	8	0	1	0	0	0	59	44	41
23:00	0	0	0	0	0	8	20	9	2	0	0	0	0	39	46	43

%	0.2%	0.5%	1.6%	2.6%	13.4%	42.9%	32.2%	5.9%	0.5%	0.1%	0.0%	0.0%	0.0%			
AM Peak Vol.	08:00	08:00	08:00	08:00	08:00	08:00	09:00	06:00	00:00	00:00	00:00			08:00		
	9	15	40	49	201	446	238	37	13	4	1			935		
Midday Peak Vol.	14:00	12:00		14:00	14:00	14:00	12:00	11:00	13:00					14:00		
	1	1		1	46	217	167	36	3					432		
PM Peak Vol.	15:00	15:00	15:00	15:00	15:00	17:00	16:00	16:00	17:00	22:00				16:00		
	3	13	39	38	167	227	189	30	4	1				514		
% ile			15th Percentile :			32 MPH										
			50th Percentile :			37 MPH										
			85th Percentile :			42 MPH										
			95th Percentile :			45 MPH										

Stats

10 MPH Pace Speed : 34-43 MPH

Number in Pace : 4896

Percent in Pace : 68.8%

Number of Vehicles > 40 MPH : 2319

Percent of Vehicles > 40 MPH : 32.6%

Mean Speed(Average) : 38 MPH



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

133213 A Speed
Site Code: TBA

Massachusetts Avenue (Route 2A)
east of Marrett Street
City, State: Lexington, MA
Client: Toole Design/ C. Fink

EB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
02/28/1																												
3	0	0	0	0	0	0	0	1	4	5	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	14	44	42
01:00	0	0	0	0	0	0	0	1	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	43	42
02:00	0	0	0	0	0	0	0	0	4	5	5	1	1	0	0	0	0	0	0	0	0	0	0	0	0	16	47	44
03:00	0	0	0	0	0	0	0	0	1	6	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	10	43	44
04:00	0	0	0	0	0	0	0	0	5	10	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	24	46	43
05:00	0	0	0	0	0	0	7	20	34	36	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	102	47	43
06:00	0	0	0	0	0	3	78	187	66	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	344	45	42
07:00	3	1	5	21	61	331	345	40	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	808	42	39
08:00	6	8	5	16	66	378	371	47	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	898	42	38
09:00	1	2	3	8	31	206	283	55	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	592	43	40
10:00	0	0	1	1	11	111	196	64	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	387	45	41
11:00	0	0	4	2	14	121	218	49	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	417	44	41
12 PM	0	0	2	1	18	149	205	54	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	434	44	40
13:00	0	1	0	0	12	106	230	55	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	409	44	41
14:00	1	0	0	1	15	114	235	70	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	443	45	41
15:00	0	0	0	6	38	227	340	58	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	676	43	40
16:00	5	0	2	4	25	182	307	86	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	614	44	40
17:00	0	0	0	1	12	145	258	85	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	507	45	41
18:00	0	0	0	2	28	175	172	32	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	412	43	40
19:00	0	0	0	0	14	84	125	55	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	280	45	41
20:00	0	0	0	1	8	49	72	30	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	166	45	41
21:00	0	0	0	0	4	28	68	16	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	118	44	41
22:00	0	0	0	0	2	24	36	16	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	84	46	42
23:00	0	0	0	0	1	16	21	17	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	58	46	43

%	0.2%	0.2%	0.3%	0.8%	4.8%	32.7%	47.7%	12.1%	1.1%	0.1%	0.0%	0.0%	0.0%															
AM Peak Vol.	08:00	08:00	07:00	07:00	08:00	08:00	08:00	06:00	06:00	00:00																08:00		
	6	8	5	21	66	378	371	66	10	1																898		
Midday Peak Vol.	14:00	13:00	11:00	11:00	12:00	12:00	14:00	14:00	11:00	13:00																14:00		
	1	1	4	2	18	149	235	70	9	1																443		
PM Peak Vol.	16:00		16:00	15:00	15:00	15:00	15:00	16:00	17:00	15:00																15:00		
	5		2	6	38	227	340	86	6	2																676		
% ile			15th Percentile :			35 MPH																						
			50th Percentile :			40 MPH																						
			85th Percentile :			44 MPH																						
			95th Percentile :			47 MPH																						

Stats

10 MPH Pace Speed : 36-45 MPH

Number in Pace : 5757

Percent in Pace : 73.6%

Number of Vehicles > 40 MPH : 3973

Percent of Vehicles > 40 MPH : 50.8%

Mean Speed(Average) : 40 MPH



PRECISION
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INDUSTRIES, LLC

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Massachusetts Avenue (Route 2A)
east of Marrett Street
City, State: Lexington, MA
Client: Toole Design/ C. Fink

133213 A Speed
Site Code: TBA

EB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
03/01/1																
3	0	0	0	1	0	2	6	4	0	0	0	0	0	13	46	42
01:00	0	0	0	0	0	1	6	4	4	0	0	0	0	15	50	46
02:00	0	0	0	0	0	3	4	4	0	0	0	1	0	12	46	44
03:00	0	0	0	0	1	0	3	2	1	1	0	0	0	8	43	45
04:00	0	0	0	0	1	6	12	11	1	0	0	0	0	31	47	43
05:00	0	0	0	0	3	14	32	27	12	1	1	0	0	90	49	44
06:00	0	0	0	10	17	86	161	55	9	0	0	0	0	338	45	41
07:00	1	1	1	12	56	314	301	49	2	0	0	0	0	737	43	39
08:00	12	6	23	31	87	295	313	47	4	0	0	0	0	818	42	37
09:00	0	0	0	0	27	182	284	59	3	0	0	0	0	555	44	40
10:00	0	0	0	0	8	106	221	81	3	1	0	0	0	420	45	42
11:00	0	0	0	1	22	160	239	45	2	0	0	0	0	469	43	40
12 PM	0	0	0	3	12	130	211	70	8	0	0	0	0	434	45	41
13:00	0	0	0	1	17	95	220	47	5	0	0	0	0	385	44	41
14:00	0	0	0	1	25	142	246	92	6	0	0	0	0	512	45	41
15:00	0	0	0	2	28	155	327	109	7	0	0	0	0	628	45	41
16:00	1	3	4	3	24	223	240	65	7	1	0	0	0	571	44	40
17:00	0	0	0	2	33	204	198	56	1	0	0	0	0	494	44	40
18:00	0	0	0	1	19	160	195	54	4	0	0	0	0	433	44	40
19:00	0	0	0	4	21	75	110	42	5	0	0	0	0	257	45	41
20:00	0	0	0	0	1	39	63	20	3	0	0	0	0	126	45	41
21:00	0	0	0	0	2	42	51	26	5	0	0	0	0	126	46	42
22:00	0	0	0	0	0	20	38	20	0	1	0	0	0	79	46	42
23:00	0	0	0	0	0	14	37	19	4	0	0	0	0	74	46	43

%	0.2%	0.1%	0.4%	0.9%	5.3%	32.4%	46.1%	13.2%	1.3%	0.1%	0.0%	0.0%	0.0%			
AM Peak	08:00	08:00	08:00	08:00	08:00	07:00	08:00	09:00	05:00	03:00	05:00	02:00		08:00		
Vol.	12	6	23	31	87	314	313	59	12	1	1	1		818		
Midday Peak				12:00	14:00	11:00	14:00	14:00	12:00					14:00		
Vol.				3	25	160	246	92	8					512		
PM Peak	16:00	16:00	16:00	19:00	17:00	16:00	15:00	15:00	15:00	16:00				15:00		
Vol.	1	3	4	4	33	223	327	109	7	1				628		
% ile			15th Percentile :			35 MPH										
			50th Percentile :			40 MPH										
			85th Percentile :			44 MPH										
			95th Percentile :			47 MPH										

Stats 10 MPH Pace Speed : 36-45 MPH
 Number in Pace : 5501
 Percent in Pace : 72.1%
 Number of Vehicles > 40 MPH : 3876
 Percent of Vehicles > 40 MPH : 50.8%
 Mean Speed(Average) : 40 MPH



PRECISION
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Massachusetts Avenue (Route 2A)
east of Marrett Street
City, State: Lexington, MA
Client: Toole Design/ C. Fink

133213 A Speed
Site Code: TBA

EB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
03/02/1																												
3	0	0	0	0	1	0	9	13	8	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	33	46	42
01:00	0	0	0	0	0	0	2	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	43	41
02:00	0	0	0	0	0	0	3	1	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	47	44
03:00	0	0	0	0	0	0	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	42	42
04:00	0	0	0	0	0	0	0	8	3	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	51	46
05:00	0	0	0	0	0	0	0	14	11	3	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	30	48	46
06:00	0	0	0	0	0	1	11	39	24	14	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	90	49	44
07:00	0	0	1	1	2	24	76	49	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	161	47	43
08:00	0	0	0	0	3	39	135	57	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	243	46	43
09:00	0	0	0	0	8	93	154	58	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	316	45	41
10:00	0	0	0	1	10	104	208	70	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	400	45	41
11:00	1	0	0	7	20	144	232	44	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	449	44	40
12 PM	0	0	0	2	17	116	208	74	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	424	45	41
13:00	0	0	1	4	10	108	244	61	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	44	41
14:00	0	0	0	9	38	142	205	55	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	452	44	40
15:00	0	0	0	2	18	147	220	47	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	437	44	40
16:00	0	0	0	1	14	87	231	74	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	409	45	42
17:00	0	0	0	1	9	105	193	39	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	355	44	41
18:00	0	0	0	4	6	80	130	36	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	261	44	41
19:00	0	0	0	0	5	31	86	45	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	176	47	43
20:00	0	0	0	0	3	14	48	24	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	93	46	43
21:00	0	0	0	0	5	37	42	29	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	116	46	42
22:00	0	0	0	1	4	23	33	22	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	85	46	42
23:00	0	0	0	1	1	17	38	21	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80	46	42

%	0.0%	0.0%	0.0%	0.7%	3.4%	26.3%	50.5%	16.9%	1.9%	0.2%	0.0%	0.0%	0.0%															
AM Peak Vol.			07:00	00:00	09:00	09:00	09:00	09:00	06:00	07:00	00:00															09:00		
			1	1	8	93	154	58	14	2	1															316		
Midday Peak Vol.	11:00		13:00	14:00	14:00	11:00	13:00	12:00	12:00	12:00																14:00		
	1		1	9	38	144	244	74	6	1																452		
PM Peak Vol.				18:00	15:00	15:00	16:00	16:00	19:00	21:00																15:00		
				4	18	147	231	74	9	2																437		
% ile			15th Percentile :			36 MPH																						
			50th Percentile :			40 MPH																						
			85th Percentile :			45 MPH																						
			95th Percentile :			48 MPH																						

Stats 10 MPH Pace Speed : 37-46 MPH
 Number in Pace : 3711
 Percent in Pace : 73.0%
 Number of Vehicles > 40 MPH : 2970
 Percent of Vehicles > 40 MPH : 58.4%
 Mean Speed(Average) : 41 MPH



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Client: Toole Design/ C. Fink

133213 A Speed
Site Code: TBA

EB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
03/03/1																												
3	0	0	0	0	0	0	0	0	6	12	7	2	0	0	0	0	0	0	0	0	0	0	0	0	0	27	47	43
01:00	0	0	0	0	0	0	0	1	3	9	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	18	46	42
02:00	0	0	0	0	0	0	0	0	1	3	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	6	42	45
03:00	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4	*	44
04:00	0	0	0	0	0	0	0	0	2	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	6	*	44
05:00	0	0	0	0	1	0	0	0	0	6	6	1	0	0	1	0	0	0	0	0	0	0	0	0	0	15	48	45
06:00	0	0	0	0	0	2	7	18	20	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	53	48	44
07:00	0	0	0	0	0	0	12	33	35	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	90	48	44
08:00	0	0	0	0	0	11	38	89	53	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	194	46	42
09:00	0	0	0	0	0	2	46	131	57	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	243	46	42
10:00	0	0	0	0	0	5	79	178	70	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	337	45	42
11:00	0	0	0	0	0	3	81	153	99	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	344	46	42
12 PM	0	0	0	0	0	5	88	212	82	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	398	46	42
13:00	0	0	0	0	0	6	121	213	54	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	399	44	41
14:00	0	0	0	0	1	13	122	199	55	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	393	44	41
15:00	0	0	0	0	3	31	137	205	46	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	424	44	40
16:00	0	0	0	0	0	23	131	173	51	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	380	44	40
17:00	0	0	0	0	1	6	69	128	68	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	276	46	42
18:00	0	8	2	0	0	2	65	98	22	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	202	44	39
19:00	0	0	0	0	0	4	30	77	36	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	153	46	42
20:00	0	0	0	0	0	4	31	45	11	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	92	44	41
21:00	0	0	0	0	0	6	20	29	12	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	71	45	41
22:00	0	0	0	0	0	4	7	17	8	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41	48	42
23:00	0	0	0	0	1	3	5	9	9	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	48	42

%	0.0%	0.2%	0.0%	0.2%	3.1%	26.3%	48.6%	19.3%	2.1%	0.2%	0.1%	0.0%	0.0%															
AM Peak Vol.				05:00	08:00	09:00	09:00	09:00	07:00	09:00	02:00			09:00														
				1	11	46	131	57	10	1	1			243														
Midday Peak Vol.				14:00	14:00	14:00	13:00	11:00	12:00	13:00	14:00			13:00														
				1	13	122	213	99	10	2	1			399														
PM Peak Vol.	18:00	18:00	15:00	15:00	15:00	15:00	15:00	17:00	19:00	18:00				15:00														
	8	2	3	31	137	205	68	6	1					424														
% ile			15th Percentile :				36 MPH																					
			50th Percentile :				41 MPH																					
			85th Percentile :				45 MPH																					
			95th Percentile :				48 MPH																					

Stats
10 MPH Pace Speed : 37-46 MPH
Number in Pace : 3021
Percent in Pace : 72.0%
Number of Vehicles > 40 MPH : 2499
Percent of Vehicles > 40 MPH : 59.6%
Mean Speed(Average) : 41 MPH



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

Massachusetts Avenue (Route 2A)
east of Marrett Street
City, State: Lexington, MA
Client: Toole Design/ C. Fink

133213 A Speed
Site Code: TBA

EB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
03/04/1																
3	0	0	0	0	1	1	4	1	0	0	0	0	0	7	43	41
01:00	0	0	0	0	0	2	3	2	0	0	0	0	0	7	43	42
02:00	0	0	0	0	0	0	2	2	1	0	0	0	0	5	*	46
03:00	0	0	0	0	0	1	2	4	1	0	0	0	0	8	48	45
04:00	0	0	0	0	0	6	8	13	4	0	0	0	0	31	49	44
05:00	0	0	0	0	0	19	36	35	13	1	0	0	0	104	49	44
06:00	0	0	0	0	9	90	186	74	3	1	0	0	0	363	45	42
07:00	0	2	2	8	58	344	308	48	2	0	0	0	0	772	43	39
08:00	5	1	16	55	158	344	274	40	2	0	0	0	0	895	42	37
09:00	0	0	0	2	24	182	248	70	1	0	0	0	0	527	44	40
10:00	0	1	3	1	6	73	223	54	10	1	0	0	0	372	45	42
11:00	0	0	1	6	18	94	162	81	7	0	0	0	0	369	45	41
12 PM	0	0	0	0	12	108	178	55	7	0	0	0	0	360	45	41
13:00	0	0	1	4	12	103	162	52	4	1	0	0	0	339	45	41
14:00	0	0	0	2	26	112	182	93	7	1	0	0	0	423	46	41
15:00	1	0	0	0	12	205	335	72	5	1	0	0	0	631	44	41
16:00	0	1	0	2	18	165	270	79	4	0	0	0	0	539	44	41
17:00	0	0	0	3	21	181	265	66	5	0	0	0	0	541	44	41
18:00	0	0	0	3	37	155	155	42	1	0	0	0	0	393	43	40
19:00	0	0	0	0	13	96	107	27	1	1	0	0	0	245	43	40
20:00	0	0	0	0	5	49	65	17	4	1	0	0	0	141	44	41
21:00	0	0	0	1	2	17	48	24	7	0	0	0	0	99	47	43
22:00	0	0	1	0	1	15	25	15	1	0	0	0	0	58	46	42
23:00	0	0	0	0	0	8	18	15	3	0	0	0	0	44	47	43

%	0.1%	0.1%	0.3%	1.2%	6.0%	32.6%	44.9%	13.5%	1.3%	0.1%	0.0%	0.0%	0.0%															
AM Peak Vol.	08:00	07:00	08:00	08:00	08:00	07:00	07:00	06:00	05:00	05:00																08:00		
	5	2	16	55	158	344	308	74	13	1																895		
Midday Peak Vol.			11:00	11:00	14:00	14:00	14:00	14:00	11:00	13:00																14:00		
			1	6	26	112	182	93	7	1																423		
PM Peak Vol.	15:00	16:00	22:00	17:00	18:00	15:00	15:00	16:00	21:00	15:00																15:00		
	1	1	1	3	37	205	335	79	7	1																631		
% ile			15th Percentile :			34 MPH																						
			50th Percentile :			40 MPH																						
			85th Percentile :			44 MPH																						
			95th Percentile :			47 MPH																						

Stats
10 MPH Pace Speed : 36-45 MPH
Number in Pace : 5185
Percent in Pace : 71.3%
Number of Vehicles > 40 MPH : 3656
Percent of Vehicles > 40 MPH : 50.3%
Mean Speed(Average) : 40 MPH

Massachusetts Avenue (Route 2A)
east of Marrett Street
City, State: Lexington, MA
Client: Toole Design/ C. Fink



133213 A Volume
Site Code: TBA

Start	WB		EB		Combined		26-Feb-13 Tue
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
12:00	5	117	5	98	10	215	
12:15	5	122	3	111	8	233	
12:30	3	124	2	102	5	226	
12:45	0	116	4	90	4	206	880
01:00	3	124	1	106	4	230	
01:15	3	125	2	98	5	223	
01:30	1	104	1	111	2	215	
01:45	2	117	1	97	3	214	882
02:00	3	115	2	98	5	213	
02:15	1	131	1	121	2	252	
02:30	2	139	2	128	4	267	
02:45	3	140	1	122	4	262	994
03:00	2	152	0	178	2	330	
03:15	6	140	2	154	8	294	
03:30	1	140	3	162	4	302	
03:45	4	154	2	153	6	307	1233
04:00	3	206	2	133	5	339	
04:15	8	175	7	146	15	321	
04:30	2	171	12	138	14	309	
04:45	7	188	9	148	16	336	1305
05:00	17	236	13	143	30	379	
05:15	18	226	17	137	35	363	
05:30	33	203	38	149	71	352	
05:45	83	190	37	131	120	321	1415
06:00	80	215	79	100	159	315	
06:15	112	184	72	126	184	310	
06:30	145	164	109	102	254	266	
06:45	145	118	118	88	263	206	1097
07:00	186	110	148	66	334	176	
07:15	217	84	179	86	396	170	
07:30	189	77	201	51	390	128	
07:45	208	95	211	57	419	152	626
08:00	161	79	220	48	381	127	
08:15	135	61	258	59	393	120	
08:30	157	51	233	34	390	85	
08:45	174	55	209	31	383	86	418
09:00	146	59	196	28	342	87	
09:15	158	33	163	25	321	58	
09:30	136	50	139	14	275	64	
09:45	134	44	126	20	260	64	273
10:00	96	30	127	27	223	57	
10:15	86	22	118	16	204	38	
10:30	86	28	78	16	164	44	
10:45	84	23	105	7	189	30	169
11:00	89	10	94	19	183	29	
11:15	85	17	117	12	202	29	
11:30	117	11	112	13	229	24	
11:45	111	9	101	3	212	12	94
Total	3452	5284	3680	4102	7132	9386	
Percent	48.4%	56.3%	51.6%	43.7%			
Day Total		8736		7782		16518	
Peak	07:00	05:00	07:45	03:00	07:15	04:45	
Vol.	800	855	922	647	1586	1430	
P.H.F.	0.922	0.906	0.893	0.909	0.946	0.943	

Massachusetts Avenue (Route 2A)
east of Marrett Street
City, State: Lexington, MA
Client: Toole Design/ C. Fink



133213 A Volume
Site Code: TBA

Start	WB		EB		Combined		27-Feb-13 Wed	
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.		
12:00	7	101	3	99	10	200		
12:15	1	97	2	73	3	170		
12:30	4	93	27	95	31	188		
12:45	4	16	107	398	6	38	91	358
01:00	2	122	3	75	5	197		
01:15	3	108	2	89	5	197		
01:30	1	99	7	66	8	165		
01:45	2	8	92	421	0	12	90	320
02:00	1	101	4	104	5	205		
02:15	1	114	2	99	3	213		
02:30	2	124	2	126	4	250		
02:45	2	6	119	458	2	10	103	432
03:00	3	115	4	144	7	259		
03:15	3	75	2	103	5	178		
03:30	3	12	5	82	8	94		
03:45	6	15	108	310	1	12	114	443
04:00	3	161	2	87	5	248		
04:15	6	164	8	147	14	311		
04:30	3	195	6	145	9	340		
04:45	10	22	192	712	11	27	135	514
05:00	14	213	13	127	27	340		
05:15	19	246	15	130	34	376		
05:30	45	216	30	111	75	327		
05:45	62	140	184	859	35	93	119	487
06:00	59	224	52	109	111	333		
06:15	112	207	61	97	173	304		
06:30	126	184	99	84	225	268		
06:45	158	455	133	748	135	347	94	384
07:00	174	101	165	72	339	173		
07:15	180	69	193	55	373	124		
07:30	190	73	197	64	387	137		
07:45	183	727	75	318	233	788	49	240
08:00	160	83	234	52	394	135		
08:15	155	68	221	34	376	102		
08:30	142	76	243	27	385	103		
08:45	151	608	42	269	237	935	43	156
09:00	145	61	181	22	326	83		
09:15	129	60	178	24	307	84		
09:30	137	35	141	27	278	62		
09:45	142	553	45	201	114	614	21	94
10:00	92	25	86	21	178	46		
10:15	95	21	89	12	184	33		
10:30	80	21	77	14	157	35		
10:45	91	358	9	76	90	342	12	59
11:00	74	10	93	17	167	27		
11:15	87	8	87	11	174	19		
11:30	87	9	104	9	191	18		
11:45	113	361	4	31	88	372	2	39
Total	3269	4801	3590	3526	6859	8327		
Percent	47.7%	57.7%	52.3%	42.3%				
Day Total		8070		7116		15186		
Peak	07:00	05:15	08:00	04:15	07:30	04:30		
Vol.	727	870	935	554	1573	1383		
P.H.F.	0.957	0.884	0.962	0.942	0.945	0.920		

Massachusetts Avenue (Route 2A)
east of Marrett Street
City, State: Lexington, MA
Client: Toole Design/ C. Fink



133213 A Volume
Site Code: TBA

Start	WB		EB		Combined		28-Feb-13 Thu
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
12:00	9	129	4	114	13	243	
12:15	9	120	4	109	13	229	
12:30	3	125	3	116	6	241	
12:45	3	122	3	95	6	217	930
01:00	5	97	1	92	6	189	
01:15	4	119	2	113	6	232	
01:30	2	135	2	95	4	230	
01:45	2	111	1	109	3	220	871
02:00	1	148	5	97	6	245	
02:15	4	129	4	107	8	236	
02:30	3	122	5	125	8	247	
02:45	1	152	2	114	3	266	994
03:00	2	146	2	199	4	345	
03:15	3	160	1	161	4	321	
03:30	2	166	3	157	5	323	
03:45	3	165	4	159	7	324	1313
04:00	4	214	3	156	7	370	
04:15	2	212	6	149	8	361	
04:30	4	202	9	166	13	368	
04:45	13	210	6	143	19	353	1452
05:00	16	228	9	123	25	351	
05:15	20	199	17	147	37	346	
05:30	49	236	27	124	76	360	
05:45	74	208	49	113	123	321	1378
06:00	73	165	58	121	131	286	
06:15	104	190	66	98	170	288	
06:30	156	154	97	90	253	244	
06:45	177	127	123	103	300	230	1048
07:00	192	111	164	86	356	197	
07:15	193	112	177	79	370	191	
07:30	213	90	222	66	435	156	
07:45	165	83	245	49	410	132	676
08:00	158	67	232	54	390	121	
08:15	184	76	252	55	436	131	
08:30	165	69	225	29	390	98	
08:45	163	63	189	28	352	91	441
09:00	144	54	171	42	315	96	
09:15	134	62	158	19	292	81	
09:30	125	48	138	36	263	84	
09:45	112	36	125	21	237	57	318
10:00	89	39	93	29	182	68	
10:15	84	28	113	23	197	51	
10:30	75	25	101	12	176	37	
10:45	96	21	80	20	176	41	197
11:00	103	16	74	20	177	36	
11:15	85	17	91	19	176	36	
11:30	80	12	124	9	204	21	
11:45	118	11	128	10	246	21	114
Total	3426	5531	3618	4201	7044	9732	
Percent	48.6%	56.8%	51.4%	43.2%			
Day Total	8957		7819		16776		
Peak	06:45	04:45	07:45	03:00	07:30	04:00	
Vol.	775	873	954	676	1671	1452	
P.H.F.	0.910	0.925	0.946	0.849	0.958	0.981	

Massachusetts Avenue (Route 2A)
east of Marrett Street
City, State: Lexington, MA
Client: Toole Design/ C. Fink



133213 A Volume
Site Code: TBA

Start	WB		EB		Combined		01-Mar-13 Fri
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
12:00	14	113	4	97	18	210	
12:15	8	109	0	89	8	198	
12:30	1	120	5	117	6	237	
12:45	1	128	4	131	5	259	904
01:00	2	142	7	106	9	248	
01:15	2	101	3	88	5	189	
01:30	2	117	5	103	7	220	
01:45	4	117	0	88	4	205	862
02:00	1	131	2	111	3	242	
02:15	3	150	2	109	5	259	
02:30	3	130	1	157	4	287	
02:45	3	145	7	135	10	280	1068
03:00	0	145	1	193	1	338	
03:15	0	163	1	158	1	321	
03:30	6	159	2	140	8	299	
03:45	3	186	4	137	7	323	1281
04:00	5	180	4	139	9	319	
04:15	8	164	11	152	19	316	
04:30	7	205	9	147	16	352	
04:45	6	188	7	133	13	321	1308
05:00	12	218	9	135	21	353	
05:15	22	190	20	113	42	303	
05:30	35	196	25	132	60	328	
05:45	72	175	36	114	108	289	1273
06:00	70	199	45	114	115	313	
06:15	115	161	73	105	188	266	
06:30	140	143	105	93	245	236	
06:45	137	112	115	121	252	233	1048
07:00	182	98	149	87	331	185	
07:15	170	77	185	67	355	144	
07:30	194	84	189	57	383	141	
07:45	205	68	214	46	419	114	584
08:00	158	63	237	38	395	101	
08:15	170	54	211	29	381	83	
08:30	128	52	208	27	336	79	
08:45	153	52	162	32	315	84	347
09:00	142	57	132	43	274	100	
09:15	106	55	158	30	264	85	
09:30	118	43	136	22	254	65	
09:45	123	43	129	31	252	74	324
10:00	106	45	106	20	212	65	
10:15	102	80	104	25	206	105	
10:30	97	51	116	18	213	69	
10:45	110	28	94	16	204	44	283
11:00	79	28	100	15	179	43	
11:15	107	18	122	21	229	39	
11:30	90	16	124	24	214	40	
11:45	130	15	123	14	253	29	151
Total	3352	5314	3506	4119	6858	9433	
Percent	48.9%	56.3%	51.1%	43.7%			
Day Total	8666		7625		16291		
Peak	07:00	04:30	07:45	02:30	07:30	04:15	
Vol.	751	801	870	643	1578	1342	
P.H.F.	0.916	0.919	0.918	0.833	0.942	0.950	

Massachusetts Avenue (Route 2A)
east of Marrett Street
City, State: Lexington, MA
Client: Toole Design/ C. Fink



133213 A Volume
Site Code: TBA

Start	WB		EB		Combined		02-Mar-13 Sat
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
12:00	10	104	15	100	25	204	
12:15	11	118	6	113	17	231	
12:30	7	121	3	101	10	222	
12:45	5	127	9	110	14	237	894
01:00	4	121	3	119	7	240	
01:15	4	109	2	113	6	222	
01:30	8	122	2	101	10	223	
01:45	6	120	2	100	8	220	905
02:00	1	127	2	105	3	232	
02:15	3	131	3	121	6	252	
02:30	2	124	1	121	3	245	
02:45	0	97	3	105	3	202	931
03:00	1	108	0	123	1	231	
03:15	2	117	2	123	4	240	
03:30	3	127	1	99	4	226	
03:45	6	123	2	92	8	215	912
04:00	1	97	3	113	4	210	
04:15	1	106	6	102	7	208	
04:30	4	105	4	107	8	212	
04:45	4	103	3	87	7	190	820
05:00	5	84	3	110	8	194	
05:15	5	98	6	95	11	193	
05:30	13	81	4	69	17	150	
05:45	13	100	17	81	30	181	718
06:00	20	91	13	69	33	160	
06:15	26	86	18	65	44	151	
06:30	39	78	26	63	65	141	
06:45	44	90	33	64	77	154	606
07:00	42	56	29	55	71	111	
07:15	59	65	39	32	98	97	
07:30	63	56	39	40	102	96	
07:45	60	40	54	49	114	89	393
08:00	45	50	36	32	81	82	
08:15	71	44	55	20	126	64	
08:30	74	44	57	20	131	64	
08:45	77	32	95	21	172	53	263
09:00	53	58	68	15	121	73	
09:15	81	62	82	42	163	104	
09:30	79	53	69	26	148	79	
09:45	92	41	97	33	189	74	330
10:00	73	44	95	30	168	74	
10:15	69	27	86	25	155	52	
10:30	94	27	104	17	198	44	
10:45	108	39	115	13	223	52	222
11:00	103	42	100	24	203	66	
11:15	106	35	102	23	208	58	
11:30	95	15	117	17	212	32	
11:45	111	16	130	16	241	32	188
Total	1803	3861	1761	3321	3564	7182	
Percent	50.6%	53.8%	49.4%	46.2%			
Day Total	5664		5082		10746		
Peak	11:00	01:45	11:00	02:30	11:00	01:45	
Vol.	415	502	449	472	864	949	
P.H.F.	0.935	0.958	0.863	0.959	0.896	0.941	

Massachusetts Avenue (Route 2A)
east of Marrett Street
City, State: Lexington, MA
Client: Toole Design/ C. Fink



133213 A Volume
Site Code: TBA

Start	WB			EB			Combined			03-Mar-13
Time	A.M.		P.M.	A.M.		P.M.	A.M.		P.M.	Sun
12:00	13		86	11		87	24		173	
12:15	8		111	8		86	16		197	
12:30	15		137	4		111	19		248	
12:45	8	44	114	4	27	114	12	71	228	846
01:00	3		105	6		102	9		207	
01:15	5		107	5		92	10		199	
01:30	4		98	0		102	4		200	
01:45	3	15	127	7	18	103	10	33	230	836
02:00	3		99	4		114	7		213	
02:15	1		101	2		85	3		186	
02:30	4		112	0		87	4		199	
02:45	2	10	108	0	6	107	2	16	215	813
03:00	4		100	3		104	7		204	
03:15	0		103	0		112	0		215	
03:30	2		101	1		116	3		217	
03:45	1	7	108	0	4	92	1	11	200	836
04:00	3		115	0		83	3		198	
04:15	2		116	3		110	5		226	
04:30	0		97	3		103	3		200	
04:45	6	11	90	0	6	84	6	17	174	798
05:00	0		67	3		65	3		132	
05:15	3		101	4		71	7		172	
05:30	10		79	2		72	12		151	
05:45	15	28	68	6	15	68	21	43	136	591
06:00	9		59	12		50	21		109	
06:15	18		64	8		56	26		120	
06:30	29		70	17		44	46		114	
06:45	22	78	80	16	53	52	38	131	132	475
07:00	36		69	22		33	58		102	
07:15	49		55	12		47	61		102	
07:30	37		45	30		37	67		82	
07:45	36	158	45	26	90	36	62	248	81	367
08:00	30		51	27		24	57		75	
08:15	40		45	26		23	66		68	
08:30	41		28	52		28	93		56	
08:45	49	160	35	89	194	17	138	354	52	251
09:00	40		34	69		25	109		59	
09:15	52		29	59		22	111		51	
09:30	77		18	48		13	125		31	
09:45	62	231	18	67	243	11	129	474	29	170
10:00	65		16	76		8	141		24	
10:15	76		7	84		16	160		23	
10:30	84		15	88		11	172		26	
10:45	115	340	10	89	337	6	204	677	16	89
11:00	85		6	85		16	170		22	
11:15	86		12	87		5	173		17	
11:30	78		2	89		6	167		8	
11:45	76	325	4	83	344	4	159	669	8	55
Total	1407		3267	1337		2860	2744		6127	
Percent	51.3%		53.3%	48.7%		46.7%				
Day Total		4674			4197			8871		
Peak	10:30		00:15	10:45		02:45	10:30		00:30	
Vol.	370		467	350		439	719		882	
P.H.F.	0.804		0.852	0.983		0.946	0.881		0.889	

Massachusetts Avenue (Route 2A)
east of Marrett Street
City, State: Lexington, MA
Client: Toole Design/ C. Fink



133213 A Volume
Site Code: TBA

Start		WB		EB		Combined		04-Mar-13 Mon	
Time	A.M.	P.M.		A.M.	P.M.	A.M.	P.M.		
12:00	9	90		2	98	11	188		
12:15	3	122		1	103	4	225		
12:30	2	110		3	82	5	192		
12:45	1	113	435	1	77	2	190	795	
01:00	3	130		0	74	3	204		
01:15	1	135		5	92	6	227		
01:30	1	97		0	88	1	185		
01:45	1	113	475	2	85	3	198	814	
02:00	2	116		1	85	3	201		
02:15	0	130		2	82	2	212		
02:30	0	134		1	143	1	277		
02:45	1	152	532	1	113	2	265	955	
03:00	1	154		1	168	2	322		
03:15	1	129		2	158	3	287		
03:30	1	143		2	158	3	301		
03:45	4	162	588	3	147	7	309	1219	
04:00	5	173		6	133	11	306		
04:15	6	165		7	138	13	303		
04:30	7	178		6	139	13	317		
04:45	4	222	738	12	129	16	351	1277	
05:00	30	203		10	150	40	353		
05:15	26	239		19	135	45	374		
05:30	46	229		39	130	85	359		
05:45	73	183	854	36	126	109	309	1395	
06:00	72	173		49	109	121	282		
06:15	101	163		83	103	184	266		
06:30	144	156		88	93	232	249		
06:45	187	133	625	143	88	330	221	1018	
07:00	184	116		150	73	334	189		
07:15	163	89		196	84	359	173		
07:30	161	74		217	50	378	124		
07:45	194	57	336	209	38	403	95	581	
08:00	184	58		236	49	420	107		
08:15	168	53		248	38	416	91		
08:30	140	47		216	19	356	66		
08:45	146	37	195	195	35	341	72	336	
09:00	112	48		160	24	272	72		
09:15	121	49		144	24	265	73		
09:30	106	44		117	21	223	65		
09:45	87	30	171	106	30	193	60	270	
10:00	91	30		100	17	191	47		
10:15	93	22		96	17	189	39		
10:30	83	13		85	11	168	24		
10:45	77	17	82	91	13	168	30	140	
11:00	88	14		105	13	193	27		
11:15	106	11		95	11	201	22		
11:30	92	5		88	12	180	17		
11:45	103	13	43	81	8	184	21	87	
Total	3231	5074		3460	3813	6691	8887		
Percent	48.3%	57.1%		51.7%	42.9%				
Day Total		8305			7273		15578		
Peak	07:30	04:45		07:30	03:00	07:30	04:45		
Vol.	707	893		910	631	1617	1437		
P.H.F.	0.911	0.934		0.917	0.939	0.963	0.961		

Massachusetts Avenue (Route 2A)
east of Marrett Street
City, State: Lexington, MA
Client: Toole Design/ C. Fink



133213 A Volume
Site Code: TBA

Start Time	26-Feb-13		27-Feb-13		28-Feb-13		01-Mar-13		02-Mar-13		03-Mar-13		04-Mar-13		Week Average	
	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB
12:00 AM	13	14	16	38	24	14	24	13	33	33	44	27	15	7	24	21
01:00	9	5	8	12	13	6	10	15	22	9	15	18	6	7	12	10
02:00	9	6	6	10	9	16	10	12	6	9	10	6	3	5	8	9
03:00	13	7	15	12	10	10	9	8	12	5	7	4	7	8	10	8
04:00	20	30	22	27	23	24	26	31	10	16	11	6	22	31	19	24
05:00	151	105	140	93	159	102	141	90	36	30	28	15	175	104	119	77
06:00	482	378	455	347	510	344	462	338	129	90	78	53	504	363	374	273
07:00	800	739	727	788	763	808	751	737	224	161	158	90	702	772	589	585
08:00	627	920	608	935	670	898	609	818	267	243	160	194	638	895	511	700
09:00	574	624	553	614	515	592	489	555	305	316	231	243	426	527	442	496
10:00	352	428	358	342	344	387	415	420	344	400	340	337	344	372	357	384
11:00	402	424	361	372	386	417	406	469	415	449	325	344	389	369	383	406
12:00 PM	479	401	398	358	496	434	470	434	470	424	448	398	435	360	457	401
01:00	470	412	421	320	462	409	477	385	472	433	437	399	475	339	459	385
02:00	525	469	458	432	551	443	556	512	479	452	420	393	532	423	503	446
03:00	586	647	310	443	637	676	653	628	475	437	412	424	588	631	523	555
04:00	740	565	712	514	838	614	737	571	411	409	418	380	738	539	656	513
05:00	855	560	859	487	871	507	779	494	363	355	315	276	854	541	699	460
06:00	681	416	748	384	636	412	615	433	345	261	273	202	625	393	560	357
07:00	366	260	318	240	396	280	327	257	217	176	214	153	336	245	311	230
08:00	246	172	269	156	275	166	221	126	170	93	159	92	195	141	219	135
09:00	186	87	201	94	200	118	198	126	214	116	99	71	171	99	181	102
10:00	103	66	76	59	113	84	204	79	137	85	48	41	82	58	109	67
11:00	47	47	31	39	56	58	77	74	108	80	24	31	43	44	55	53
Total	8736	7782	8070	7116	8957	7819	8666	7625	5664	5082	4674	4197	8305	7273	7580	6697
Day	16518		15186		16776		16291		10746		8871		15578		14277	
AM Peak	07:00	08:00	07:00	08:00	07:00	08:00	07:00	08:00	11:00	11:00	10:00	11:00	07:00	08:00	07:00	08:00
Vol.	800	920	727	935	763	898	751	818	415	449	340	344	702	895	589	700
PM Peak	17:00	15:00	17:00	16:00	17:00	15:00	17:00	15:00	14:00	14:00	12:00	15:00	17:00	15:00	17:00	15:00
Vol.	855	647	859	514	871	676	779	628	479	452	448	424	854	631	699	555

Comb. Total	16518	15186	16776	16291	10746	8871	15578	14277
ADT	ADT 14,281	AADT 14,281						



PRECISION
D A T A
INDUSTRIES, LLC

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123082 B Class
Site Code: TBA

Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

NB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/13/1														
2	0	1	0	0	0	0	0	0	0	0	0	0	0	1
01:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
02:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	1	3	0	0	0	0	0	0	0	0	0	0	0	4
05:00	0	8	1	0	0	1	0	0	0	0	0	0	0	10
06:00	0	62	7	0	0	0	0	0	0	0	0	0	0	69
07:00	0	155	11	2	3	0	0	1	0	0	0	0	0	172
08:00	0	225	21	0	0	3	0	1	0	0	0	0	0	250
09:00	0	117	22	1	1	0	0	0	0	0	0	0	0	141
10:00	0	53	5	1	3	1	0	2	0	0	0	0	0	65
11:00	0	44	4	1	1	0	0	2	0	0	0	0	0	52
12 PM	0	72	15	0	3	0	0	0	0	0	0	0	0	90
13:00	0	50	10	0	1	0	0	0	0	0	0	0	0	61
14:00	0	54	12	1	4	1	0	0	0	0	0	0	0	72
15:00	1	115	27	2	3	0	0	1	0	0	0	0	0	149
16:00	0	185	28	1	3	1	0	0	0	0	0	0	0	218
17:00	0	178	15	0	1	1	0	0	0	0	0	0	0	195
18:00	0	142	13	0	0	0	0	0	0	0	0	0	0	155
19:00	0	55	7	0	1	0	0	0	0	0	0	0	0	63
20:00	0	42	2	0	1	0	0	0	0	0	0	0	0	45
21:00	0	35	0	0	0	0	0	0	0	0	0	0	0	35
22:00	0	14	1	0	0	0	0	0	0	0	0	0	0	15
23:00	0	5	0	0	0	0	0	0	0	0	0	0	0	5
Total	2	1617	201	9	25	8	0	7	0	0	0	0	0	1869
Percent	0.1%	86.5%	10.8%	0.5%	1.3%	0.4%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	04:00	08:00	09:00	07:00	07:00	08:00		10:00						08:00
Vol.	1	225	22	2	3	3		2						250
PM Peak	15:00	16:00	16:00	15:00	14:00	14:00		15:00						16:00
Vol.	1	185	28	2	4	1		1						218



PRECISION
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Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

123082 B Class
Site Code: TBA

NB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/14/1														
2	0	5	0	0	0	0	0	0	0	0	0	0	0	5
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	1	4	0	0	0	0	0	0	0	0	0	0	0	5
05:00	0	6	0	0	0	0	0	0	1	0	0	0	0	7
06:00	0	46	10	0	1	0	0	0	0	0	0	0	0	57
07:00	1	174	20	1	3	1	0	0	0	0	0	0	0	200
08:00	1	243	26	0	2	0	0	1	0	0	0	0	0	273
09:00	0	123	19	1	0	1	0	1	0	0	0	0	0	145
10:00	0	75	19	1	4	0	0	0	0	0	0	0	0	99
11:00	1	73	16	0	1	0	0	0	0	0	0	0	0	91
12 PM	0	108	28	3	4	1	0	1	0	0	0	0	0	145
13:00	1	102	18	2	3	1	0	2	0	0	0	0	0	129
14:00	1	111	20	0	0	0	0	0	0	0	0	0	0	132
15:00	0	123	27	0	3	1	0	0	0	0	0	0	0	154
16:00	0	170	27	0	2	0	0	1	0	0	0	0	0	200
17:00	0	186	29	0	2	0	0	0	0	0	0	0	0	217
18:00	1	135	18	0	1	0	0	0	0	0	0	0	0	155
19:00	0	49	7	0	0	0	0	0	0	0	0	0	0	56
20:00	0	43	3	0	0	0	0	0	0	0	0	0	0	46
21:00	0	30	3	0	0	0	0	0	0	0	0	0	0	33
22:00	0	19	4	0	0	0	0	0	0	0	0	0	0	23
23:00	0	11	1	0	0	0	0	0	0	0	0	0	0	12
Total	7	1836	295	8	26	5	0	6	1	0	0	0	0	2184
Percent	0.3%	84.1%	13.5%	0.4%	1.2%	0.2%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	04:00	08:00	08:00	07:00	10:00	07:00		08:00	05:00					08:00
Vol.	1	243	26	1	4	1		1	1					273
PM Peak	13:00	17:00	17:00	12:00	12:00	12:00		13:00						17:00
Vol.	1	186	29	3	4	1		2						217



PRECISION
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123082 B Class
Site Code: TBA

Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

NB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/15/1														
2	0	5	0	0	0	0	0	0	0	0	0	0	0	5
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
03:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
04:00	1	3	0	0	0	0	0	0	0	0	0	0	0	4
05:00	0	9	0	0	0	0	0	0	0	0	0	0	0	9
06:00	0	61	10	0	1	0	0	0	0	0	0	0	0	72
07:00	1	153	13	2	2	0	0	0	1	0	0	0	0	172
08:00	3	201	27	3	1	0	0	0	0	1	0	0	0	236
09:00	0	101	18	0	0	0	0	0	0	0	0	0	0	119
10:00	0	71	12	1	2	0	0	0	0	0	0	0	0	86
11:00	0	62	10	0	0	0	0	0	0	0	0	0	0	72
12 PM	0	82	17	0	1	1	0	0	0	0	0	0	0	101
13:00	0	60	6	0	1	0	0	0	0	0	0	0	0	67
14:00	0	63	16	1	4	0	0	0	0	0	0	0	0	84
15:00	0	115	28	3	1	0	0	0	0	0	0	0	0	147
16:00	0	166	30	0	5	1	0	0	0	0	0	0	0	202
17:00	0	178	24	0	0	1	0	2	0	0	0	0	0	205
18:00	0	124	17	0	1	1	0	0	0	0	0	0	0	143
19:00	0	55	3	0	0	0	0	0	0	0	0	0	0	58
20:00	0	37	4	0	1	0	0	0	0	0	0	0	0	42
21:00	0	23	3	0	0	0	0	0	0	0	0	0	0	26
22:00	0	25	1	0	0	0	0	0	0	0	0	0	0	26
23:00	0	10	1	0	0	0	0	0	0	0	0	0	0	11
Total	5	1606	240	10	20	4	0	2	1	1	0	0	0	1889
Percent	0.3%	85.0%	12.7%	0.5%	1.1%	0.2%	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	
AM Peak	08:00	08:00	08:00	08:00	07:00				07:00	08:00				08:00
Vol.	3	201	27	3	2				1	1				236
PM Peak		17:00	16:00	15:00	16:00	12:00		17:00						17:00
Vol.		178	30	3	5	1		2						205



PRECISION
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Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

123082 B Class
Site Code: TBA

NB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/16/1														
2	0	5	0	0	0	0	0	0	0	0	0	0	0	5
01:00	0	0	2	0	0	0	0	0	0	0	0	0	0	2
02:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
03:00	0	2	1	0	0	0	0	0	0	0	0	0	0	3
04:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
05:00	0	12	2	0	0	0	0	0	0	0	0	0	0	14
06:00	0	43	10	0	0	0	0	0	0	0	0	0	0	53
07:00	0	150	14	2	3	0	0	0	1	0	0	0	0	170
08:00	4	214	27	0	1	0	0	0	0	0	0	0	0	246
09:00	0	91	13	0	2	0	0	1	0	0	0	0	0	107
10:00	1	66	9	1	0	0	0	1	0	0	0	0	0	78
11:00	0	60	6	0	2	1	0	0	0	0	0	0	0	69
12 PM	0	67	12	0	1	0	0	1	0	0	0	0	0	81
13:00	3	60	10	0	4	0	0	0	0	0	0	0	0	77
14:00	0	86	13	1	1	0	0	0	0	0	0	0	0	101
15:00	0	115	19	3	2	1	0	0	0	0	0	0	0	140
16:00	1	159	20	0	5	1	0	0	0	0	0	0	0	186
17:00	1	206	13	0	2	0	0	0	0	0	0	0	0	222
18:00	0	166	15	0	2	0	0	0	0	0	0	0	0	183
19:00	0	41	1	0	1	0	0	0	0	0	0	0	0	43
20:00	0	20	6	0	0	0	0	0	0	0	0	0	0	26
21:00	0	23	0	0	0	0	0	0	0	0	0	0	0	23
22:00	0	26	2	0	0	0	0	0	0	0	0	0	0	28
23:00	0	4	0	0	0	0	0	0	0	0	0	0	0	4
Total	10	1620	195	7	26	3	0	3	1	0	0	0	0	1865
Percent	0.5%	86.9%	10.5%	0.4%	1.4%	0.2%	0.0%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	
AM Peak	08:00	08:00	08:00	07:00	07:00	11:00		09:00	07:00					08:00
Vol.	4	214	27	2	3	1		1	1					246
PM Peak	13:00	17:00	16:00	15:00	16:00	15:00		12:00						17:00
Vol.	3	206	20	3	5	1		1						222



PRECISION
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INDUSTRIES, LLC

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Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

123082 B Class
Site Code: TBA

NB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/17/1														
2	0	11	0	0	0	0	0	0	0	0	0	0	0	11
01:00	0	3	0	0	0	0	0	0	0	0	0	0	0	3
02:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
05:00	0	4	0	0	0	0	0	0	0	0	0	0	0	4
06:00	1	9	1	0	0	0	0	0	0	0	0	0	0	11
07:00	0	27	3	0	1	0	0	0	0	0	0	0	0	31
08:00	2	70	9	0	1	0	0	0	0	0	0	0	0	82
09:00	1	116	14	0	1	0	0	0	0	0	0	0	0	132
10:00	0	107	14	0	1	0	0	0	0	0	0	0	0	122
11:00	0	117	15	0	0	0	0	0	0	0	0	0	0	132
12 PM	0	127	7	0	2	0	0	0	0	0	0	0	0	136
13:00	6	122	12	0	3	0	0	0	0	0	0	0	0	143
14:00	4	130	19	0	1	0	0	0	0	0	0	0	0	154
15:00	0	94	14	0	1	0	0	0	0	0	0	0	0	109
16:00	0	52	7	0	0	0	0	0	0	0	0	0	0	59
17:00	0	62	2	0	0	0	0	1	0	0	0	0	0	65
18:00	0	39	8	0	0	0	0	0	0	0	0	0	0	47
19:00	0	19	0	0	0	0	0	0	0	0	0	0	0	19
20:00	0	14	3	0	0	0	0	0	0	0	0	0	0	17
21:00	0	18	1	0	0	0	0	0	0	0	0	0	0	19
22:00	0	19	1	0	0	0	0	0	0	0	0	0	0	20
23:00	0	9	2	0	0	0	0	0	0	0	0	0	0	11
Total	14	1172	132	0	11	0	0	1	0	0	0	0	0	1330
Percent	1.1%	88.1%	9.9%	0.0%	0.8%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	08:00	11:00	11:00		07:00									09:00
Vol.	2	117	15		1									132
PM Peak	13:00	14:00	14:00		13:00			17:00						14:00
Vol.	6	130	19		3			1						154



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Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

123082 B Class
Site Code: TBA

NB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/18/1														
2	0	7	2	0	0	0	0	0	0	0	0	0	0	9
01:00	0	5	0	0	0	0	0	0	0	0	0	0	0	5
02:00	0	4	0	0	0	0	0	0	0	0	0	0	0	4
03:00	0	4	0	0	0	0	0	0	0	0	0	0	0	4
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
06:00	0	8	2	0	0	0	0	0	0	0	0	0	0	10
07:00	0	16	2	0	0	0	0	0	0	0	0	0	0	18
08:00	0	33	3	0	0	0	0	0	0	0	0	0	0	36
09:00	0	36	5	0	0	0	0	0	0	0	0	0	0	41
10:00	3	47	4	0	2	0	0	0	0	0	0	0	0	56
11:00	3	41	3	0	0	1	0	0	0	0	0	0	0	48
12 PM	1	68	10	0	0	0	0	0	0	0	0	0	0	79
13:00	5	63	9	0	0	0	0	0	0	0	0	0	0	77
14:00	3	67	8	0	0	0	0	1	0	0	0	0	0	79
15:00	2	53	12	0	0	0	0	0	0	0	0	0	0	67
16:00	0	56	8	0	1	0	0	0	0	0	0	0	0	65
17:00	0	40	7	0	2	0	0	0	0	0	0	0	0	49
18:00	0	23	3	0	2	0	0	0	0	0	0	0	0	28
19:00	0	21	3	0	0	0	0	0	0	0	0	0	0	24
20:00	0	18	2	0	0	0	0	0	0	0	0	0	0	20
21:00	0	10	2	0	0	0	0	0	0	0	0	0	0	12
22:00	0	6	2	0	0	0	0	0	0	0	0	0	0	8
23:00	0	6	2	0	0	0	0	0	0	0	0	0	0	8
Total	17	633	89	0	7	1	0	1	0	0	0	0	0	748
Percent	2.3%	84.6%	11.9%	0.0%	0.9%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	10:00	10:00	09:00		10:00	11:00								10:00
Vol.	3	47	5		2	1								56
PM Peak	13:00	12:00	15:00		17:00			14:00						12:00
Vol.	5	68	12		2			1						79



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Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

123082 B Class
Site Code: TBA

NB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/19/1														
2	0	3	0	0	0	0	0	0	0	0	0	0	0	3
01:00	0	3	0	0	0	0	0	0	0	0	0	0	0	3
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	1	1	1	0	0	0	0	0	0	0	0	0	0	3
05:00	0	10	2	0	0	0	0	0	0	0	0	0	0	12
06:00	0	50	7	0	2	0	0	0	0	0	0	0	0	59
07:00	2	158	10	3	4	0	0	1	0	1	0	0	0	179
08:00	1	239	24	0	2	0	0	0	0	0	0	0	0	266
09:00	0	82	21	0	1	2	0	0	0	0	0	0	0	106
10:00	0	62	9	0	2	0	0	0	0	0	0	0	0	73
11:00	0	43	12	0	2	0	0	0	0	0	0	0	0	57
12 PM	1	57	17	0	2	0	0	0	1	0	0	0	0	78
13:00	2	45	13	0	4	0	0	0	0	0	0	0	0	64
14:00	0	47	11	0	1	0	0	0	0	0	0	0	0	59
15:00	1	113	33	4	4	0	0	0	0	0	0	0	0	155
16:00	0	153	35	0	4	0	0	0	0	0	0	0	0	192
17:00	0	167	19	0	1	0	0	0	0	0	0	0	0	187
18:00	0	115	18	0	0	0	0	0	0	0	0	0	0	133
19:00	0	52	4	0	2	0	0	0	0	0	0	0	0	58
20:00	0	32	8	0	0	0	0	0	0	0	0	0	0	40
21:00	0	12	3	0	0	0	0	0	0	0	0	0	0	15
22:00	0	11	1	0	0	0	0	0	0	0	0	0	0	12
23:00	0	3	0	0	0	0	0	0	0	0	0	0	0	3
Total	8	1458	248	7	31	2	0	1	1	1	0	0	0	1757
Percent	0.5%	83.0%	14.1%	0.4%	1.8%	0.1%	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	
AM Peak	07:00	08:00	08:00	07:00	07:00	09:00		07:00		07:00				08:00
Vol.	2	239	24	3	4	2		1		1				266
PM Peak	13:00	17:00	16:00	15:00	13:00				12:00					16:00
Vol.	2	167	35	4	4				1					192
Total		9942	1400	41	146	23	0	21	4	2	0	0	0	11642



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Bedford Road
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Client: Toole Design Group/ C. Fink

123082 B Class
Site Code: TBA

SB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/13/1														
2	0	4	0	0	0	0	0	0	0	0	0	0	0	4
01:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	1	0	0	0	0	0	0	0	0	0	0	1
04:00	0	2	1	0	0	0	0	0	0	0	0	0	0	3
05:00	0	13	4	0	2	0	0	0	0	0	0	0	0	19
06:00	0	99	19	0	1	0	0	0	0	0	0	0	0	119
07:00	1	278	39	1	5	0	0	0	0	0	0	0	0	324
08:00	0	263	34	0	1	0	0	0	0	0	0	0	0	298
09:00	0	139	19	1	2	0	0	3	0	0	0	0	0	164
10:00	0	52	8	2	5	0	0	0	0	0	0	0	0	67
11:00	0	64	20	0	0	0	0	0	0	0	0	0	0	84
12 PM	0	54	14	0	0	0	0	0	0	0	0	0	0	68
13:00	0	44	9	0	3	1	0	1	0	0	0	0	0	58
14:00	0	93	17	2	3	0	0	2	0	0	0	0	0	117
15:00	0	204	33	2	2	1	0	0	0	0	0	0	0	242
16:00	1	321	35	0	2	0	0	0	0	0	0	0	0	359
17:00	1	358	33	0	0	0	0	0	0	0	0	0	0	392
18:00	0	196	29	0	1	0	0	0	0	0	0	0	0	226
19:00	0	77	8	1	0	0	0	0	0	0	0	0	0	86
20:00	0	27	3	0	0	0	0	0	0	0	0	0	0	30
21:00	0	35	1	0	1	0	0	0	0	0	0	0	0	37
22:00	1	11	2	0	0	0	0	0	0	0	0	0	0	14
23:00	0	3	0	0	0	0	0	0	0	0	0	0	0	3
Total	4	2339	329	9	28	2	0	6	0	0	0	0	0	2717
Percent	0.1%	86.1%	12.1%	0.3%	1.0%	0.1%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	07:00	07:00	07:00	10:00	07:00			09:00						07:00
Vol.	1	278	39	2	5			3						324
PM Peak	16:00	17:00	16:00	14:00	13:00	13:00		14:00						17:00
Vol.	1	358	35	2	3	1		2						392



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123082 B Class
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SB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/14/1														
2	0	2	0	0	0	0	0	0	0	0	0	0	0	2
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	2	1	0	0	0	0	0	0	0	0	0	0	3
05:00	0	15	2	0	1	0	0	0	0	0	0	0	0	18
06:00	0	89	17	0	2	0	0	0	0	0	0	0	0	108
07:00	1	273	51	2	7	0	0	0	0	0	0	0	0	334
08:00	1	273	45	0	2	0	0	1	0	0	0	0	0	322
09:00	1	151	28	1	3	0	0	0	0	0	0	0	0	184
10:00	0	78	22	0	2	0	0	1	0	0	0	0	0	103
11:00	0	73	28	1	1	0	0	0	0	0	0	0	0	103
12 PM	1	111	26	1	1	0	0	0	0	0	0	0	0	140
13:00	1	127	23	2	0	0	0	1	0	0	0	0	0	154
14:00	0	94	30	1	2	0	0	0	0	0	0	0	0	127
15:00	2	204	24	0	2	0	0	0	0	0	0	0	0	232
16:00	2	258	30	2	2	0	0	1	0	0	0	0	0	295
17:00	0	328	29	0	2	0	0	0	0	0	0	0	0	359
18:00	1	204	35	0	1	0	0	0	0	0	0	0	0	241
19:00	0	83	11	0	0	0	0	0	0	0	0	0	0	94
20:00	0	38	3	0	0	0	0	0	0	0	0	0	0	41
21:00	0	18	1	0	0	0	0	0	0	0	0	0	0	19
22:00	0	13	3	0	0	0	0	0	0	0	0	0	0	16
23:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
Total	10	2436	409	10	28	0	0	4	0	0	0	0	0	2897
Percent	0.3%	84.1%	14.1%	0.3%	1.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	07:00	07:00	07:00	07:00	07:00			08:00						07:00
Vol.	1	273	51	2	7			1						334
PM Peak	15:00	17:00	18:00	13:00	14:00			13:00						17:00
Vol.	2	328	35	2	2			1						359



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SB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/15/1														
2	0	3	0	0	0	0	0	0	0	0	0	0	0	3
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	1	1	0	0	0	0	0	0	0	0	0	0	2
05:00	0	18	3	0	1	0	0	0	0	0	0	0	0	22
06:00	0	92	18	0	2	0	0	0	0	0	0	0	0	112
07:00	0	307	36	2	6	0	0	0	0	0	0	0	0	351
08:00	0	247	40	0	6	0	0	1	0	0	0	0	0	294
09:00	0	111	20	1	2	0	0	0	0	0	0	0	0	134
10:00	0	62	14	1	1	0	0	0	0	0	0	0	0	78
11:00	0	62	16	0	2	0	0	0	0	0	0	0	0	80
12 PM	0	75	16	1	1	0	0	2	0	0	0	0	0	95
13:00	0	56	13	0	3	0	0	0	0	0	0	0	0	72
14:00	0	81	16	2	3	0	0	1	0	0	0	0	0	103
15:00	0	180	28	3	5	0	0	0	0	0	0	0	0	216
16:00	0	299	37	0	4	0	0	0	0	0	0	0	0	340
17:00	1	322	32	0	2	0	0	0	0	0	0	0	0	357
18:00	0	185	25	1	0	0	0	0	0	0	0	0	0	211
19:00	0	57	7	0	1	0	0	0	0	0	0	0	0	65
20:00	0	31	5	0	0	0	0	0	0	0	0	0	0	36
21:00	0	30	5	0	0	0	0	0	0	0	0	0	0	35
22:00	0	11	1	0	0	0	0	0	0	0	0	0	0	12
23:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Total	1	2231	333	11	39	0	0	4	0	0	0	0	0	2619
Percent	0.0%	85.2%	12.7%	0.4%	1.5%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak		07:00	08:00	07:00	07:00			08:00						07:00
Vol.		307	40	2	6			1						351
PM Peak	17:00	17:00	16:00	15:00	15:00			12:00						17:00
Vol.	1	322	37	3	5			2						357



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SB

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11/16/1														
2	0	4	1	0	0	0	0	0	0	0	0	0	0	5
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
03:00	0	0	2	0	0	0	0	0	0	0	0	0	0	2
04:00	0	4	1	0	0	0	0	0	0	0	0	0	0	5
05:00	0	16	5	0	1	0	0	0	0	0	0	0	0	22
06:00	0	89	16	0	3	0	0	0	0	0	0	0	0	108
07:00	0	275	37	1	4	0	0	0	0	0	0	0	0	317
08:00	1	222	32	0	7	0	0	0	1	0	0	0	0	263
09:00	0	90	18	2	2	0	0	0	0	0	0	0	0	112
10:00	0	64	12	1	0	0	0	0	0	0	0	0	0	77
11:00	0	76	11	1	2	0	0	0	0	0	0	0	0	90
12 PM	0	73	11	0	1	1	0	0	0	0	0	0	0	86
13:00	2	60	12	0	2	0	0	1	0	0	0	0	0	77
14:00	0	85	13	0	2	0	0	1	0	0	0	0	0	101
15:00	0	217	17	2	2	0	0	0	0	0	0	0	0	238
16:00	0	257	29	0	2	0	0	1	0	0	0	0	0	289
17:00	0	267	24	0	0	0	0	1	0	0	0	0	0	292
18:00	1	95	17	0	2	0	0	0	0	0	0	0	0	115
19:00	0	44	6	0	1	0	0	0	0	0	0	0	0	51
20:00	0	33	4	0	0	0	0	0	0	0	0	0	0	37
21:00	1	24	2	0	0	0	0	0	0	0	0	0	0	27
22:00	0	18	1	0	0	0	0	0	0	0	0	0	0	19
23:00	0	11	2	0	0	0	0	0	0	0	0	0	0	13
Total	5	2025	273	7	31	1	0	4	1	0	0	0	0	2347
Percent	0.2%	86.3%	11.6%	0.3%	1.3%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	08:00	07:00	07:00	09:00	08:00				08:00					07:00
Vol.	1	275	37	2	7				1					317
PM Peak	13:00	17:00	16:00	15:00	13:00	12:00		13:00						17:00
Vol.	2	267	29	2	2	1		1						292



PRECISION
D A T A
INDUSTRIES, LLC

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Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

123082 B Class
Site Code: TBA

SB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/17/1														
2	0	1	0	0	0	0	0	0	0	0	0	0	0	1
01:00	0	3	0	0	0	0	0	0	0	0	0	0	0	3
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
04:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
05:00	0	2	0	0	1	0	0	0	0	0	0	0	0	3
06:00	0	10	2	0	0	0	0	0	0	0	0	0	0	12
07:00	0	32	7	0	0	0	0	0	0	0	0	0	0	39
08:00	0	53	12	0	3	0	0	1	0	0	0	0	0	69
09:00	0	106	18	0	2	0	0	0	0	0	0	0	0	126
10:00	0	96	16	0	0	0	0	1	0	0	0	0	0	113
11:00	1	111	14	0	3	0	0	0	0	0	0	0	0	129
12 PM	0	119	15	0	0	0	0	0	0	0	0	0	0	134
13:00	2	111	19	0	2	0	0	0	0	0	0	0	0	134
14:00	0	101	18	0	0	0	0	0	0	0	0	0	0	119
15:00	0	104	14	0	3	0	0	0	0	0	0	0	0	121
16:00	0	73	11	0	0	0	0	0	0	0	0	0	0	84
17:00	0	58	8	0	0	0	0	0	0	0	0	0	0	66
18:00	0	36	3	2	0	0	0	0	0	0	0	0	0	41
19:00	0	36	5	0	0	0	0	0	0	0	0	0	0	41
20:00	0	23	5	0	0	0	0	0	0	0	0	0	0	28
21:00	0	23	3	0	0	0	0	0	0	0	0	0	0	26
22:00	0	8	2	0	0	0	0	0	0	0	0	0	0	10
23:00	1	13	1	0	0	0	0	0	0	0	0	0	0	15
Total	4	1122	173	2	14	0	0	2	0	0	0	0	0	1317
Percent	0.3%	85.2%	13.1%	0.2%	1.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	11:00	11:00	09:00		08:00			08:00						11:00
Vol.	1	111	18		3			1						129
PM Peak	13:00	12:00	13:00	18:00	15:00									12:00
Vol.	2	119	19	2	3									134



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123082 B Class
Site Code: TBA

Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

SB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/18/1														
2	0	3	0	0	0	0	0	0	0	0	0	0	0	3
01:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
02:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
03:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00	0	3	0	0	0	0	0	0	0	0	0	0	0	3
06:00	0	10	1	0	0	0	0	0	0	0	0	0	0	11
07:00	0	13	3	0	0	0	0	0	0	0	0	0	0	16
08:00	0	20	3	0	1	0	0	0	0	0	0	0	0	24
09:00	0	39	5	0	1	0	0	0	0	0	0	0	0	45
10:00	0	57	11	0	0	0	0	0	0	0	0	0	0	68
11:00	1	52	9	0	0	0	0	0	0	0	0	0	0	62
12 PM	0	73	7	0	4	0	0	0	0	0	0	0	0	84
13:00	1	80	13	0	1	0	0	0	0	0	0	0	0	95
14:00	0	61	13	0	2	0	0	0	0	0	0	0	0	76
15:00	0	61	10	0	1	0	0	0	0	0	0	0	0	72
16:00	0	57	13	0	1	0	0	0	0	0	0	0	0	71
17:00	2	36	5	0	0	0	0	0	0	0	0	0	0	43
18:00	0	29	6	0	0	0	0	0	0	0	0	0	0	35
19:00	0	25	5	0	0	0	0	0	0	0	0	0	0	30
20:00	0	21	2	0	0	0	0	0	0	0	0	0	0	23
21:00	1	17	0	0	0	0	0	0	0	0	0	0	0	18
22:00	0	6	0	0	1	0	0	0	0	0	0	0	0	7
23:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Total	5	667	106	0	12	0	0	0	0	0	0	0	0	790
Percent	0.6%	84.4%	13.4%	0.0%	1.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	11:00	10:00	10:00		08:00									10:00
Vol.	1	57	11		1									68
PM Peak	17:00	13:00	13:00		12:00									13:00
Vol.	2	80	13		4									95



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123082 B Class
Site Code: TBA

Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

SB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/19/1														
2	0	3	0	0	0	0	0	0	0	0	0	0	0	3
01:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
02:00	0	0	2	0	0	0	0	0	0	0	0	0	0	2
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	2	2	0	0	0	0	0	0	0	0	0	0	4
05:00	0	19	1	0	2	0	0	0	0	0	0	0	0	22
06:00	0	91	13	0	2	0	0	0	0	0	0	0	0	106
07:00	1	295	39	1	5	0	0	1	0	0	0	0	0	342
08:00	0	243	51	0	5	1	0	0	3	0	0	0	0	303
09:00	0	125	25	1	4	0	0	0	1	0	0	0	0	156
10:00	1	53	7	0	1	0	0	0	0	0	0	0	0	62
11:00	0	59	18	0	2	2	0	0	0	0	0	0	0	81
12 PM	1	79	15	0	4	0	0	0	0	0	0	0	0	99
13:00	0	74	10	0	3	1	0	0	1	0	0	0	0	89
14:00	0	80	22	1	5	1	2	0	0	0	0	0	0	111
15:00	0	180	25	1	7	0	0	1	0	0	0	0	0	214
16:00	1	243	49	1	2	0	0	1	0	0	0	0	0	297
17:00	3	281	34	1	2	0	0	0	0	0	0	0	0	321
18:00	2	221	28	0	3	0	0	0	0	0	0	0	0	254
19:00	0	71	12	0	2	0	0	0	0	0	0	0	0	85
20:00	0	37	2	0	0	0	0	0	0	0	0	0	0	39
21:00	0	20	2	0	0	0	0	0	0	0	0	0	0	22
22:00	0	8	4	0	1	0	0	0	0	0	0	0	0	13
23:00	0	4	0	0	0	0	0	0	0	0	0	0	0	4
Total	9	2190	361	6	50	5	2	3	5	0	0	0	0	2631
Percent	0.3%	83.2%	13.7%	0.2%	1.9%	0.2%	0.1%	0.1%	0.2%	0.0%	0.0%	0.0%	0.0%	
AM Peak	07:00	07:00	08:00	07:00	07:00	11:00		07:00	08:00					07:00
Vol.	1	295	51	1	5	2		1	3					342
PM Peak	17:00	17:00	16:00	14:00	15:00	13:00	14:00	15:00	13:00					17:00
Vol.	3	281	49	1	7	1	2	1	1					321
Total		13010	1984	45	202	8	2	23	6	0	0	0	0	15318



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123082 B Speed
Site Code: TBA

NB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
11/13/1																												
2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	*	32
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	*	57
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	*	47
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
04:00	0	0	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	*	32
05:00	0	0	1	1	3	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	33	35
06:00	0	0	0	1	19	43	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	69	39	36
07:00	0	0	1	8	76	75	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	172	38	35
08:00	0	0	1	18	103	101	24	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	250	38	35
09:00	0	0	0	7	68	54	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	141	38	35
10:00	0	0	1	2	20	31	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	65	39	36
11:00	0	5	2	2	5	29	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	52	39	33
12 PM	0	0	1	5	31	43	8	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	90	38	35
13:00	0	0	0	2	17	31	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	61	40	36
14:00	0	1	0	5	24	31	9	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	72	39	35
15:00	0	0	2	5	60	64	17	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	149	38	35
16:00	0	1	1	18	113	74	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	218	37	34
17:00	0	0	4	28	97	61	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	195	36	33
18:00	0	0	1	18	78	54	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	155	37	33
19:00	0	0	0	3	21	31	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	63	39	36
20:00	0	0	0	1	13	23	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	40	37
21:00	0	0	0	1	10	18	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	39	36
22:00	0	0	0	0	3	6	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	42	38
23:00	0	1	0	0	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	41	33

%	0.0%	0.4%	0.8%	6.7%	40.9%	41.3%	8.6%	1.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%														
AM Peak Vol.			05:00	08:00	08:00	08:00	08:00	08:00		01:00																08:00		
			1	18	103	101	24	3		1																250		
Midday Peak Vol.		11:00	11:00	12:00	12:00	12:00	13:00	12:00																		12:00		
		5	2	5	31	43	11	2																		90		
PM Peak Vol.		16:00	17:00	17:00	16:00	16:00	15:00	20:00																		16:00		
		1	4	28	113	74	17	3																		218		
% ile			15th Percentile :			29 MPH																						
			50th Percentile :			34 MPH																						
			85th Percentile :			38 MPH																						
			95th Percentile :			41 MPH																						

Stats

10 MPH Pace Speed : 30-39 MPH

Number in Pace : 1384

Percent in Pace : 74.1%

Number of Vehicles > 35 MPH : 799

Percent of Vehicles > 35 MPH : 42.7%

Mean Speed(Average) : 35 MPH



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Site Code: TBA

NB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
11/14/1																												
2	0	0	0	0	0	0	0	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	*	38
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
04:00	0	0	0	0	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	*	33
05:00	0	0	1	1	2	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	*	33
06:00	0	0	0	2	17	28	9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	57	40	36
07:00	0	0	3	23	66	80	26	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	200	39	35
08:00	0	0	0	18	92	131	30	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	273	39	35
09:00	0	0	0	8	71	54	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	145	38	34
10:00	0	0	0	4	23	52	18	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	99	40	37
11:00	0	1	1	4	32	35	14	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	91	40	35
12 PM	0	0	1	4	34	82	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	145	40	36
13:00	0	0	0	6	53	53	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	129	39	35
14:00	0	1	0	5	46	66	12	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	132	39	35
15:00	0	0	0	6	36	89	19	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	154	39	36
16:00	0	0	0	9	67	96	26	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	200	39	36
17:00	0	0	3	24	81	92	16	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	217	38	34
18:00	0	0	1	4	65	66	16	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	155	39	35
19:00	0	0	0	4	22	19	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	56	40	36
20:00	0	0	0	0	19	21	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46	39	36
21:00	0	0	0	0	7	19	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33	41	37
22:00	0	1	0	0	6	7	4	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	46	38
23:00	0	0	0	0	1	6	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	41	40

%	0.0%	0.1%	0.5%	5.7%	34.0%	45.8%	12.2%	1.6%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AM Peak Vol.			07:00	07:00	08:00	08:00	08:00	07:00																		08:00		
			3	23	92	131	30	2																		273		
Midday Peak Vol.		11:00	11:00	13:00	13:00	12:00	12:00	11:00																		12:00		
		1	1	6	53	82	24	4																		145		
PM Peak Vol.		22:00	17:00	17:00	17:00	16:00	16:00	15:00	19:00																	17:00		
		1	3	24	81	96	26	4	1																	217		
% ile			15th Percentile :			30 MPH																						
			50th Percentile :			35 MPH																						
			85th Percentile :			39 MPH																						
			95th Percentile :			42 MPH																						

Stats

10 MPH Pace Speed :	31-40 MPH
Number in Pace :	1593
Percent in Pace :	72.9%
Number of Vehicles > 35 MPH :	1094
Percent of Vehicles > 35 MPH :	50.1%
Mean Speed(Average) :	35 MPH



PRECISION
D A T A
INDUSTRIES, LLC

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Email: datarequests@pdillc.com

Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

123082 B Speed
Site Code: TBA

NB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/15/1																
2	0	0	0	0	1	1	2	1	0	0	0	0	0	5	*	40
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
02:00	0	0	0	0	0	1	0	0	0	0	0	0	0	1	*	37
03:00	0	0	0	0	0	0	0	1	0	0	0	0	0	1	*	47
04:00	0	0	0	0	2	2	0	0	0	0	0	0	0	4	*	34
05:00	0	0	0	1	3	4	1	0	0	0	0	0	0	9	37	35
06:00	0	0	1	6	17	42	6	0	0	0	0	0	0	72	38	35
07:00	0	0	1	6	50	81	32	2	0	0	0	0	0	172	40	36
08:00	0	0	1	6	70	133	25	0	0	0	0	0	1	236	39	36
09:00	0	0	0	2	24	69	19	5	0	0	0	0	0	119	40	37
10:00	0	0	3	4	15	40	20	4	0	0	0	0	0	86	41	37
11:00	0	0	1	1	8	41	16	5	0	0	0	0	0	72	42	38
12 PM	0	0	0	4	26	56	14	0	1	0	0	0	0	101	39	36
13:00	0	0	0	1	18	32	13	2	1	0	0	0	0	67	40	37
14:00	0	0	0	1	23	39	19	2	0	0	0	0	0	84	40	37
15:00	0	0	3	6	47	59	32	0	0	0	0	0	0	147	40	36
16:00	0	3	0	11	61	99	25	3	0	0	0	0	0	202	39	35
17:00	0	0	1	22	89	73	17	3	0	0	0	0	0	205	38	34
18:00	0	0	0	7	39	77	19	1	0	0	0	0	0	143	39	36
19:00	0	0	0	1	15	33	8	0	0	1	0	0	0	58	39	37
20:00	0	0	0	3	11	20	7	1	0	0	0	0	0	42	40	36
21:00	0	0	0	0	3	15	7	1	0	0	0	0	0	26	41	38
22:00	0	0	0	0	9	11	6	0	0	0	0	0	0	26	40	36
23:00	0	0	0	0	1	5	2	3	0	0	0	0	0	11	45	40

%	0.0%	0.2%	0.6%	4.3%	28.2%	49.4%	15.4%	1.8%	0.1%	0.1%	0.0%	0.0%	0.1%																	
AM Peak Vol.			06:00	06:00	08:00	08:00	07:00	09:00																08:00	08:00					
			1	6	70	133	32	5															1	236						
Midday Peak Vol.			11:00	12:00	12:00	12:00	14:00	11:00	12:00																12:00					
			1	4	26	56	19	5	1																101					
PM Peak Vol.		16:00	15:00	17:00	17:00	16:00	15:00	16:00		19:00																17:00				
		3	3	22	89	99	32	3		1																205				
% ile			15th Percentile :			30 MPH																								
			50th Percentile :			35 MPH																								
			85th Percentile :			40 MPH																								
			95th Percentile :			43 MPH																								

Stats

10 MPH Pace Speed : 31-40 MPH

Number in Pace : 1372

Percent in Pace : 72.7%

Number of Vehicles > 35 MPH : 1057

Percent of Vehicles > 35 MPH : 56.0%

Mean Speed(Average) : 36 MPH



PRECISION
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123082 B Speed
Site Code: TBA

Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

NB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/16/1																
2	0	0	0	0	0	1	4	0	0	0	0	0	0	5	42	41
01:00	0	0	0	0	1	1	0	0	0	0	0	0	0	2	*	34
02:00	0	0	0	0	2	0	0	0	0	0	0	0	0	2	*	32
03:00	0	0	0	0	1	1	1	0	0	0	0	0	0	3	*	37
04:00	0	0	0	0	1	1	0	0	0	0	0	0	0	2	*	34
05:00	0	0	0	1	1	2	8	2	0	0	0	0	0	14	44	40
06:00	0	0	0	3	16	22	12	0	0	0	0	0	0	53	40	36
07:00	0	0	0	12	55	83	16	3	1	0	0	0	0	170	39	35
08:00	0	0	2	11	112	106	15	0	0	0	0	0	0	246	38	34
09:00	0	0	0	6	37	53	10	1	0	0	0	0	0	107	39	35
10:00	0	0	1	7	19	39	10	2	0	0	0	0	0	78	39	36
11:00	0	0	0	9	15	33	9	3	0	0	0	0	0	69	40	36
12 PM	0	0	1	5	35	32	7	1	0	0	0	0	0	81	38	35
13:00	0	1	2	1	24	34	13	2	0	0	0	0	0	77	40	36
14:00	0	0	0	2	40	41	15	3	0	0	0	0	0	101	40	36
15:00	0	0	1	13	38	58	26	4	0	0	0	0	0	140	40	36
16:00	0	0	0	13	71	86	15	1	0	0	0	0	0	186	38	35
17:00	1	0	5	34	84	86	12	0	0	0	0	0	0	222	37	33
18:00	0	0	1	12	68	85	16	1	0	0	0	0	0	183	38	35
19:00	0	0	0	2	7	25	7	2	0	0	0	0	0	43	40	37
20:00	0	0	0	0	9	10	4	3	0	0	0	0	0	26	42	37
21:00	0	0	0	1	9	11	1	0	1	0	0	0	0	23	37	35
22:00	0	0	0	1	5	10	8	3	1	0	0	0	0	28	43	39
23:00	0	0	0	0	2	1	1	0	0	0	0	0	0	4	*	36

%	0.1%	0.1%	0.7%	7.1%	35.0%	44.0%	11.3%	1.7%	0.2%	0.0%	0.0%	0.0%	0.0%															
AM Peak Vol.			08:00	07:00	08:00	08:00	07:00	07:00	07:00																	08:00		
			2	12	112	106	16	3	1																	246		
Midday Peak Vol.		13:00	13:00	11:00	14:00	14:00	14:00	11:00																		14:00		
		1	2	9	40	41	15	3																		101		
PM Peak Vol.	17:00		17:00	17:00	17:00	16:00	15:00	15:00	21:00																	17:00		
	1		5	34	84	86	26	4	1																	222		
% ile			15th Percentile :			29 MPH																						
			50th Percentile :			34 MPH																						
			85th Percentile :			39 MPH																						
			95th Percentile :			42 MPH																						

Stats

10 MPH Pace Speed :	31-40 MPH
Number in Pace :	1339
Percent in Pace :	71.8%
Number of Vehicles > 35 MPH :	893
Percent of Vehicles > 35 MPH :	47.9%
Mean Speed(Average) :	35 MPH



PRECISION
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Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

123082 B Speed
Site Code: TBA

NB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/17/1																
2	0	0	0	0	4	6	1	0	0	0	0	0	0	11	38	36
01:00	0	0	1	0	2	0	0	0	0	0	0	0	0	3	*	29
02:00	0	0	0	0	0	1	0	1	0	0	0	0	0	2	*	42
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
04:00	0	0	0	0	0	0	1	0	0	0	0	0	0	1	*	42
05:00	0	0	0	1	2	1	0	0	0	0	0	0	0	4	*	32
06:00	1	0	0	0	2	6	2	0	0	0	0	0	0	11	39	33
07:00	0	0	0	1	10	12	6	2	0	0	0	0	0	31	41	37
08:00	0	0	0	1	38	34	9	0	0	0	0	0	0	82	38	35
09:00	0	0	0	6	52	64	9	0	1	0	0	0	0	132	38	35
10:00	0	0	1	1	50	57	13	0	0	0	0	0	0	122	39	35
11:00	0	0	1	8	55	53	15	0	0	0	0	0	0	132	39	35
12 PM	0	0	0	6	64	59	6	1	0	0	0	0	0	136	37	35
13:00	0	4	1	13	56	60	9	0	0	0	0	0	0	143	38	33
14:00	0	0	8	11	63	64	8	0	0	0	0	0	0	154	37	34
15:00	0	0	1	7	49	42	8	2	0	0	0	0	0	109	38	35
16:00	0	0	1	3	24	20	7	4	0	0	0	0	0	59	40	35
17:00	0	1	2	9	24	21	8	0	0	0	0	0	0	65	39	33
18:00	0	0	0	2	10	20	11	4	0	0	0	0	0	47	42	38
19:00	0	0	0	0	6	10	2	1	0	0	0	0	0	19	38	36
20:00	0	0	0	0	5	8	3	1	0	0	0	0	0	17	40	37
21:00	0	0	0	0	6	7	5	1	0	0	0	0	0	19	42	37
22:00	0	0	0	2	6	11	0	1	0	0	0	0	0	20	37	35
23:00	0	0	0	1	3	5	2	0	0	0	0	0	0	11	39	36

%	0.1%	0.4%	1.2%	5.4%	39.9%	42.2%	9.4%	1.4%	0.1%	0.0%	0.0%	0.0%	0.0%			
AM Peak	06:00		01:00	09:00	09:00	09:00	08:00	07:00	09:00					09:00		
Vol.	1		1	6	52	64	9	2	1					132		
Midday Peak		13:00	14:00	13:00	12:00	14:00	11:00	12:00						14:00		
Vol.		4	8	13	64	64	15	1						154		
PM Peak		17:00	17:00	17:00	15:00	15:00	18:00	16:00						15:00		
Vol.		1	2	9	49	42	11	4						109		
% ile			15th Percentile :			29 MPH										
			50th Percentile :			34 MPH										
			85th Percentile :			38 MPH										
			95th Percentile :			42 MPH										

Stats

10 MPH Pace Speed : 30-39 MPH

Number in Pace : 982

Percent in Pace : 73.8%

Number of Vehicles > 35 MPH : 590

Percent of Vehicles > 35 MPH : 44.4%

Mean Speed(Average) : 35 MPH



PRECISION
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Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

123082 B Speed
Site Code: TBA

NB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/18/1																
2	0	0	0	0	2	3	4	0	0	0	0	0	0	9	41	38
01:00	0	0	0	0	0	3	2	0	0	0	0	0	0	5	38	39
02:00	0	0	0	0	1	2	1	0	0	0	0	0	0	4	*	37
03:00	0	0	0	0	2	1	0	1	0	0	0	0	0	4	*	37
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
05:00	0	0	0	0	1	0	0	0	0	0	0	0	0	1	*	32
06:00	0	0	0	1	2	5	1	1	0	0	0	0	0	10	38	37
07:00	0	0	0	1	1	4	9	3	0	0	0	0	0	18	44	40
08:00	0	0	1	1	8	21	4	1	0	0	0	0	0	36	39	36
09:00	0	0	1	0	8	24	7	0	1	0	0	0	0	41	40	37
10:00	1	0	4	3	10	24	14	0	0	0	0	0	0	56	41	35
11:00	0	0	4	0	17	23	1	2	0	1	0	0	0	48	37	35
12 PM	0	1	2	1	21	34	19	1	0	0	0	0	0	79	41	36
13:00	0	1	4	1	12	40	18	1	0	0	0	0	0	77	41	36
14:00	0	0	1	4	18	38	17	0	1	0	0	0	0	79	40	36
15:00	0	0	1	3	18	32	12	1	0	0	0	0	0	67	40	36
16:00	0	0	0	2	18	34	10	1	0	0	0	0	0	65	40	36
17:00	0	0	0	2	18	21	5	3	0	0	0	0	0	49	40	36
18:00	0	0	1	1	2	17	7	0	0	0	0	0	0	28	41	37
19:00	0	0	0	0	7	9	5	2	1	0	0	0	0	24	42	38
20:00	0	0	0	0	6	10	3	1	0	0	0	0	0	20	40	37
21:00	0	0	0	0	3	5	2	1	1	0	0	0	0	12	39	39
22:00	0	0	0	1	1	3	2	1	0	0	0	0	0	8	38	38
23:00	0	0	0	0	2	3	2	1	0	0	0	0	0	8	38	38

%	0.1%	0.3%	2.5%	2.8%	23.8%	47.6%	19.4%	2.8%	0.5%	0.1%	0.0%	0.0%	0.0%															
AM Peak Vol.			08:00	06:00	08:00	09:00	07:00	07:00	09:00																	09:00		
			1	1	8	24	9	3	1																	41		
Midday Peak Vol.		12:00	11:00	14:00	12:00	13:00	12:00	11:00	14:00	11:00																12:00		
		1	4	4	21	40	19	2	1	1																79		
PM Peak Vol.			15:00	15:00	15:00	16:00	15:00	17:00	19:00																	15:00		
			1	3	18	34	12	3	1																	67		
% ile			15th Percentile :			31 MPH																						
			50th Percentile :			36 MPH																						
			85th Percentile :			41 MPH																						
			95th Percentile :			44 MPH																						

Stats

10 MPH Pace Speed : 32-41 MPH

Number in Pace : 520

Percent in Pace : 69.5%

Number of Vehicles > 35 MPH : 448

Percent of Vehicles > 35 MPH : 59.8%

Mean Speed(Average) : 36 MPH



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Client: Toole Design Group/ C. Fink

123082 B Speed
Site Code: TBA

NB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
11/19/1																												
2	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	*	39
01:00	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	*	35
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
04:00	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	*	39
05:00	0	0	0	0	1	4	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	39	35	
06:00	0	0	0	0	1	16	31	10	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	59	40	37	
07:00	1	0	0	0	11	65	77	21	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	179	39	35	
08:00	0	0	0	0	14	92	137	19	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	266	38	35	
09:00	0	0	0	0	1	29	56	19	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	106	40	37	
10:00	0	0	0	1	2	14	43	9	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73	40	37	
11:00	0	0	0	0	3	8	28	17	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	57	41	37	
12 PM	0	0	0	0	3	23	36	14	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	78	40	36	
13:00	0	1	1	2	20	25	10	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64	41	36	
14:00	0	0	1	3	11	32	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	59	40	36	
15:00	0	0	7	5	34	78	26	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	155	40	36	
16:00	0	1	7	13	70	87	13	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	192	38	34	
17:00	0	0	0	0	14	90	66	16	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	187	38	34	
18:00	0	0	0	0	4	47	69	8	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	133	38	36	
19:00	0	0	0	0	4	17	23	8	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	58	41	37	
20:00	0	0	0	0	0	4	25	8	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	41	38	
21:00	0	0	0	0	0	3	8	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	41	37	
22:00	0	1	0	0	1	2	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	38	33	
23:00	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	*	37	

%	0.1%	0.2%	1.0%	4.7%	31.4%	47.8%	12.5%	2.2%	0.2%	0.1%	0.0%	0.0%	0.0%															
AM Peak	07:00			08:00	08:00	08:00	07:00	07:00	06:00																	08:00		
Vol.	1			14	92	137	21	4	1																	266		
Midday Peak		13:00	13:00	11:00	12:00	12:00	11:00	13:00		12:00																12:00		
Vol.		1	1	3	23	36	17	4		1																78		
PM Peak		16:00	15:00	17:00	17:00	16:00	15:00	19:00	15:00																	16:00		
Vol.		1	7	14	90	87	26	6	1																	192		
% ile				15th Percentile :		30 MPH																						
				50th Percentile :		35 MPH																						
				85th Percentile :		39 MPH																						
				95th Percentile :		43 MPH																						

Stats

10 MPH Pace Speed : 31-40 MPH

Number in Pace : 1280

Percent in Pace : 72.9%

Number of Vehicles > 35 MPH : 922

Percent of Vehicles > 35 MPH : 52.5%

Mean Speed(Average) : 36 MPH



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

123082 B Speed
Site Code: TBA

SB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
11/13/1																												
2	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	*	34
01:00	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	*	32
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
03:00	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	*	37
04:00	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	*	35
05:00	0	0	0	0	1	5	12	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	38	35
06:00	0	0	0	0	2	17	74	23	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	119	40	37
07:00	5	4	2	7	102	174	26	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	324	38	35
08:00	0	1	2	7	87	167	31	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	298	39	36
09:00	0	0	1	1	55	88	18	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	164	39	36
10:00	0	0	0	0	5	23	32	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	67	38	35
11:00	0	1	2	3	36	37	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	84	38	34
12 PM	0	0	1	4	17	35	9	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	68	39	36
13:00	0	0	0	0	6	21	27	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	58	38	35
14:00	0	0	0	0	8	39	50	15	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	117	40	36
15:00	1	3	2	9	89	103	32	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	242	39	35
16:00	0	1	0	21	179	128	27	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	359	38	34
17:00	0	0	0	38	194	131	24	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	392	38	34
18:00	0	0	5	13	83	94	25	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	226	39	35
19:00	0	0	0	0	5	35	33	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	86	39	35
20:00	0	0	0	6	13	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	38	34
21:00	0	0	1	3	9	20	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	37	38	35
22:00	0	0	0	0	4	4	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	41	38
23:00	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	36	37

%	0.2%	0.4%	0.6%	5.1%	37.3%	45.0%	10.0%	1.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AM Peak	07:00	07:00	07:00	07:00	07:00	07:00	08:00	07:00																		07:00		
Vol.	5	4	2	7	102	174	31	4																		324		
Midday Peak		11:00	11:00	14:00	14:00	14:00	14:00	14:00																		14:00		
Vol.		1	2	8	39	50	15	5																		117		
PM Peak	15:00	15:00	18:00	17:00	17:00	17:00	15:00	17:00	18:00																	17:00		
Vol.	1	3	5	38	194	131	32	5	1																	392		
% ile				15th Percentile :		29 MPH																						
				50th Percentile :		34 MPH																						
				85th Percentile :		39 MPH																						
				95th Percentile :		42 MPH																						

Stats

10 MPH Pace Speed :	30-39 MPH
Number in Pace :	2011
Percent in Pace :	74.0%
Number of Vehicles > 35 MPH :	1275
Percent of Vehicles > 35 MPH :	46.9%
Mean Speed(Average) :	35 MPH



PRECISION
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INDUSTRIES, LLC

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123082 B Speed
Site Code: TBA

Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

SB

Start Time	14	15	20	25	30	35	40	45	50	55	60	65	70	Total	85th % ile	Ave Speed
11/14/1																
2	0	0	0	0	1	1	0	0	0	0	0	0	0	2	*	34
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
04:00	0	0	0	2	1	0	0	0	0	0	0	0	0	3	*	29
05:00	0	0	0	1	8	7	2	0	0	0	0	0	0	18	38	35
06:00	0	0	0	3	29	55	19	2	0	0	0	0	0	108	40	36
07:00	0	2	3	8	75	192	51	2	1	0	0	0	0	334	39	36
08:00	0	0	0	8	95	163	51	5	0	0	0	0	0	322	40	36
09:00	0	0	0	6	58	93	22	3	2	0	0	0	0	184	39	36
10:00	0	1	0	2	35	53	12	0	0	0	0	0	0	103	39	35
11:00	0	0	0	5	36	49	13	0	0	0	0	0	0	103	39	35
12 PM	0	0	1	7	51	59	20	2	0	0	0	0	0	140	39	35
13:00	0	1	0	6	56	71	18	2	0	0	0	0	0	154	39	35
14:00	0	0	2	10	43	59	12	1	0	0	0	0	0	127	38	35
15:00	0	0	1	13	74	111	29	4	0	0	0	0	0	232	39	36
16:00	0	0	0	6	92	160	31	6	0	0	0	0	0	295	39	36
17:00	0	1	2	35	131	159	28	2	1	0	0	0	0	359	38	35
18:00	0	1	0	4	63	129	38	3	2	0	1	0	0	241	40	37
19:00	0	1	1	12	27	40	13	0	0	0	0	0	0	94	39	34
20:00	0	0	0	1	12	22	4	0	2	0	0	0	0	41	39	37
21:00	0	0	0	0	5	10	3	1	0	0	0	0	0	19	40	37
22:00	0	0	0	0	3	7	5	1	0	0	0	0	0	16	42	38
23:00	0	0	0	0	2	0	0	0	0	0	0	0	0	2	*	32

%	0.0%	0.2%	0.3%	4.5%	31.0%	49.7%	12.8%	1.2%	0.3%	0.0%	0.0%	0.0%	0.0%			
AM Peak		07:00	07:00	07:00	08:00	07:00	07:00	08:00	09:00					07:00		
Vol.		2	3	8	95	192	51	5	2					334		
Midday Peak		13:00	14:00	14:00	13:00	13:00	12:00	12:00						13:00		
Vol.		1	2	10	56	71	20	2						154		
PM Peak		17:00	17:00	17:00	17:00	16:00	18:00	16:00	18:00		18:00			17:00		
Vol.		1	2	35	131	160	38	6	2		1			359		
% ile			15th Percentile :			30 MPH										
			50th Percentile :			35 MPH										
			85th Percentile :			39 MPH										
			95th Percentile :			42 MPH										

Stats

10 MPH Pace Speed :	31-40 MPH
Number in Pace :	2156
Percent in Pace :	74.4%
Number of Vehicles > 35 MPH :	1542
Percent of Vehicles > 35 MPH :	53.2%
Mean Speed(Average) :	36 MPH



PRECISION
D A T A
INDUSTRIES, LLC

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Office: 508.481.3999 Fax: 508.545.1234
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Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

123082 B Speed
Site Code: TBA

SB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/15/1																
2	0	0	0	0	2	1	0	0	0	0	0	0	0	3	*	34
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
04:00	0	0	0	0	2	0	0	0	0	0	0	0	0	2	*	32
05:00	0	0	0	0	5	13	4	0	0	0	0	0	0	22	39	37
06:00	0	0	0	1	29	61	20	1	0	0	0	0	0	112	40	37
07:00	4	0	3	10	76	192	61	5	0	0	0	0	0	351	40	36
08:00	0	1	0	5	72	166	48	1	1	0	0	0	0	294	40	36
09:00	0	0	0	3	24	71	35	1	0	0	0	0	0	134	41	37
10:00	0	0	2	4	24	33	11	4	0	0	0	0	0	78	40	36
11:00	0	1	0	3	20	44	12	0	0	0	0	0	0	80	39	36
12 PM	0	0	1	7	30	44	12	0	1	0	0	0	0	95	39	35
13:00	0	1	2	6	16	31	14	2	0	0	0	0	0	72	40	35
14:00	0	0	2	8	29	45	19	0	0	0	0	0	0	103	40	35
15:00	0	0	3	8	73	95	33	4	0	0	0	0	0	216	39	36
16:00	0	0	0	6	114	171	49	0	0	0	0	0	0	340	39	36
17:00	0	0	1	12	155	155	32	2	0	0	0	0	0	357	38	35
18:00	0	0	0	5	62	111	29	4	0	0	0	0	0	211	39	36
19:00	0	0	1	4	15	36	8	1	0	0	0	0	0	65	39	36
20:00	0	0	0	1	10	19	5	1	0	0	0	0	0	36	40	36
21:00	0	0	0	1	9	18	7	0	0	0	0	0	0	35	40	36
22:00	0	0	1	3	2	4	1	1	0	0	0	0	0	12	37	34
23:00	0	0	0	0	1	0	0	0	0	0	0	0	0	1	*	32

%	0.2%	0.1%	0.6%	3.3%	29.4%	50.0%	15.3%	1.0%	0.1%	0.0%	0.0%	0.0%	0.0%			
AM Peak	07:00	08:00	07:00	07:00	07:00	07:00	07:00	07:00	08:00					07:00		
Vol.	4	1	3	10	76	192	61	5	1					351		
Midday Peak		11:00	13:00	14:00	12:00	14:00	14:00	13:00	12:00					14:00		
Vol.		1	2	8	30	45	19	2	1					103		
PM Peak			15:00	17:00	17:00	16:00	16:00	15:00						17:00		
Vol.			3	12	155	171	49	4						357		
% ile			15th Percentile :			30 MPH										
			50th Percentile :			35 MPH										
			85th Percentile :			39 MPH										
			95th Percentile :			42 MPH										

Stats

10 MPH Pace Speed :	31-40 MPH
Number in Pace :	1939
Percent in Pace :	74.0%
Number of Vehicles > 35 MPH :	1453
Percent of Vehicles > 35 MPH :	55.5%
Mean Speed(Average) :	36 MPH



PRECISION
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123082 B Speed
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Bedford Road
south of N.Great Road (Route 2A)
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Client: Toole Design Group/ C. Fink

SB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/16/1																
2	0	0	0	1	1	2	1	0	0	0	0	0	0	5	*	35
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
02:00	0	0	0	0	0	0	0	1	0	0	0	0	0	1	*	47
03:00	0	0	0	0	0	0	0	2	0	0	0	0	0	2	*	47
04:00	0	0	0	0	0	2	3	0	0	0	0	0	0	5	41	40
05:00	0	0	0	1	9	9	3	0	0	0	0	0	0	22	38	35
06:00	0	0	0	0	25	62	18	3	0	0	0	0	0	108	40	37
07:00	3	3	3	6	89	160	47	6	0	0	0	0	0	317	39	35
08:00	0	1	0	12	74	146	27	3	0	0	0	0	0	263	39	36
09:00	0	0	0	8	28	56	18	2	0	0	0	0	0	112	40	36
10:00	0	0	0	5	26	39	7	0	0	0	0	0	0	77	38	35
11:00	0	0	0	6	36	38	9	1	0	0	0	0	0	90	38	35
12 PM	0	0	2	6	31	40	7	0	0	0	0	0	0	86	38	35
13:00	0	1	1	3	41	21	10	0	0	0	0	0	0	77	38	34
14:00	0	0	0	12	28	55	5	1	0	0	0	0	0	101	38	35
15:00	1	1	3	9	65	124	32	2	1	0	0	0	0	238	39	36
16:00	0	0	1	19	90	138	40	1	0	0	0	0	0	289	39	35
17:00	0	0	0	5	108	140	35	4	0	0	0	0	0	292	39	36
18:00	0	1	1	5	40	50	16	2	0	0	0	0	0	115	39	35
19:00	0	0	0	3	17	25	6	0	0	0	0	0	0	51	39	35
20:00	0	0	1	2	13	14	7	0	0	0	0	0	0	37	40	35
21:00	0	0	0	4	12	8	2	1	0	0	0	0	0	27	37	34
22:00	0	0	0	3	4	9	0	3	0	0	0	0	0	19	38	36
23:00	0	0	0	3	4	5	1	0	0	0	0	0	0	13	37	34

%	0.2%	0.3%	0.5%	4.8%	31.6%	48.7%	12.5%	1.4%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	07:00	07:00	07:00	08:00	07:00	07:00	07:00	07:00						07:00		
Vol.	3	3	3	12	89	160	47	6						317		
Midday Peak		13:00	12:00	14:00	13:00	14:00	13:00	11:00						14:00		
Vol.		1	2	12	41	55	10	1						101		
PM Peak	15:00	15:00	15:00	16:00	17:00	17:00	16:00	17:00	15:00					17:00		
Vol.	1	1	3	19	108	140	40	4	1					292		
% ile			15th Percentile :			30 MPH										
			50th Percentile :			35 MPH										
			85th Percentile :			39 MPH										
			95th Percentile :			42 MPH										

Stats

10 MPH Pace Speed :	31-40 MPH
Number in Pace :	1731
Percent in Pace :	73.8%
Number of Vehicles > 35 MPH :	1222
Percent of Vehicles > 35 MPH :	52.1%
Mean Speed(Average) :	35 MPH



PRECISION
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123082 B Speed
Site Code: TBA

SB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/17/1																
2	0	0	0	0	1	0	0	0	0	0	0	0	0	1	*	32
01:00	0	0	1	0	1	0	1	0	0	0	0	0	0	3	*	32
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
03:00	0	0	0	0	1	1	0	0	0	0	0	0	0	2	*	34
04:00	0	0	0	0	0	1	0	0	0	0	0	0	0	1	*	37
05:00	0	0	0	0	2	1	0	0	0	0	0	0	0	3	*	34
06:00	0	0	0	0	8	2	2	0	0	0	0	0	0	12	34	35
07:00	0	0	0	0	17	19	3	0	0	0	0	0	0	39	38	35
08:00	0	0	0	2	27	24	15	1	0	0	0	0	0	69	40	36
09:00	0	0	1	7	49	56	11	2	0	0	0	0	0	126	38	35
10:00	0	0	0	3	49	47	14	0	0	0	0	0	0	113	39	35
11:00	0	0	0	6	52	54	16	1	0	0	0	0	0	129	39	35
12 PM	0	0	2	12	58	52	9	0	1	0	0	0	0	134	38	34
13:00	0	1	2	9	42	60	19	1	0	0	0	0	0	134	39	35
14:00	0	0	0	10	46	49	14	0	0	0	0	0	0	119	39	35
15:00	0	0	2	17	51	47	4	0	0	0	0	0	0	121	37	33
16:00	0	0	0	8	28	42	6	0	0	0	0	0	0	84	38	35
17:00	0	0	0	2	22	31	10	1	0	0	0	0	0	66	40	36
18:00	0	0	0	3	15	16	7	0	0	0	0	0	0	41	40	35
19:00	0	0	0	2	16	16	7	0	0	0	0	0	0	41	40	35
20:00	0	0	0	1	14	7	5	1	0	0	0	0	0	28	40	35
21:00	0	0	0	0	11	13	2	0	0	0	0	0	0	26	38	35
22:00	0	0	0	0	3	5	2	0	0	0	0	0	0	10	39	37
23:00	0	0	0	1	4	9	1	0	0	0	0	0	0	15	38	35

%	0.0%	0.1%	0.6%	6.3%	39.3%	41.9%	11.2%	0.5%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AM Peak Vol.			01:00	09:00	09:00	09:00	08:00	09:00																		09:00		
			1	7	49	56	15	2																		126		
Midday Peak Vol.		13:00	12:00	12:00	12:00	13:00	13:00	11:00	12:00																	12:00		
		1	2	12	58	60	19	1	1																	134		
PM Peak Vol.			15:00	15:00	15:00	15:00	17:00	17:00																		15:00		
			2	17	51	47	10	1																		121		
% ile			15th Percentile :			29 MPH																						
			50th Percentile :			34 MPH																						
			85th Percentile :			39 MPH																						
			95th Percentile :			42 MPH																						

Stats

10 MPH Pace Speed : 30-39 MPH

Number in Pace : 968

Percent in Pace : 73.5%

Number of Vehicles > 35 MPH : 596

Percent of Vehicles > 35 MPH : 45.3%

Mean Speed(Average) : 35 MPH



PRECISION
D A T A
INDUSTRIES, LLC

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Email: datarequests@pdillc.com

123082 B Speed
Site Code: TBA

Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

SB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/18/1																
2	0	0	0	0	3	0	0	0	0	0	0	0	0	3	31	32
01:00	0	0	0	0	0	0	1	0	0	0	0	0	0	1	*	42
02:00	0	0	0	0	0	0	0	1	0	0	0	0	0	1	*	47
03:00	0	0	0	0	0	1	0	0	0	0	0	0	0	1	*	37
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
05:00	0	0	0	0	2	1	0	0	0	0	0	0	0	3	*	34
06:00	0	0	0	2	6	3	0	0	0	0	0	0	0	11	35	32
07:00	0	0	0	0	3	10	3	0	0	0	0	0	0	16	39	37
08:00	0	0	0	2	7	12	2	1	0	0	0	0	0	24	38	36
09:00	0	0	0	0	21	19	5	0	0	0	0	0	0	45	39	35
10:00	0	0	0	0	19	33	15	1	0	0	0	0	0	68	40	37
11:00	0	0	1	6	22	25	6	1	1	0	0	0	0	62	39	35
12 PM	0	0	0	3	18	46	15	2	0	0	0	0	0	84	40	37
13:00	0	0	0	4	35	41	11	3	1	0	0	0	0	95	39	36
14:00	0	0	1	4	19	36	15	1	0	0	0	0	0	76	40	36
15:00	0	1	0	1	19	37	12	1	1	0	0	0	0	72	40	36
16:00	0	0	0	1	26	31	12	1	0	0	0	0	0	71	40	36
17:00	0	0	0	1	12	23	5	1	1	0	0	0	0	43	39	37
18:00	0	0	0	0	11	14	9	1	0	0	0	0	0	35	41	37
19:00	0	0	0	1	12	12	3	2	0	0	0	0	0	30	39	36
20:00	0	0	1	1	6	12	3	0	0	0	0	0	0	23	39	35
21:00	0	0	0	1	11	5	1	0	0	0	0	0	0	18	37	34
22:00	0	0	1	0	2	4	0	0	0	0	0	0	0	7	37	33
23:00	0	0	0	0	0	1	0	0	0	0	0	0	0	1	*	37

%	0.0%	0.1%	0.5%	3.4%	32.2%	46.3%	14.9%	2.0%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AM Peak Vol.				06:00	09:00	09:00	09:00	02:00																		09:00	
				2	21	19	5	1																		45	
Midday Peak Vol.			11:00	11:00	13:00	12:00	12:00	13:00	11:00																	13:00	
			1	6	35	46	15	3	1																	95	
PM Peak Vol.		15:00	20:00	15:00	16:00	15:00	15:00	19:00	15:00																	15:00	
		1	1	1	26	37	12	2	1																	72	
% ile			15th Percentile :			30 MPH																					
			50th Percentile :			35 MPH																					
			85th Percentile :			40 MPH																					
			95th Percentile :			43 MPH																					

Stats

10 MPH Pace Speed : 31-40 MPH

Number in Pace : 573

Percent in Pace : 72.5%

Number of Vehicles > 35 MPH : 426

Percent of Vehicles > 35 MPH : 53.9%

Mean Speed(Average) : 36 MPH



P.O.Box 301 Berlin, MA 01503
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123082 B Speed
Site Code: TBA

[illegible]

%	0.0%	0.2%	0.6%	4.5%	26.9%	49.3%	16.6%	1.6%	0.2%	0.0%	0.0%	0.0%	0.0%
AM Peak Vol.			07:00	08:00	07:00	07:00	08:00	09:00					07:00
			7	17	94	184	48	7					342
Midday Peak Vol.		14:00	11:00	13:00	13:00	14:00	11:00	13:00	11:00				14:00
		1	2	11	32	57	17	3	1				111
PM Peak Vol.		16:00	16:00	17:00	17:00	17:00	18:00	15:00	16:00		19:00		17:00
		3	2	13	94	171	56	5	2		1		321
%iles			15th Percentile :			30 MPH							
			50th Percentile :			35 MPH							
			85th Percentile :			40 MPH							
			95th Percentile :			43 MPH							

Stats	10 MPH Pace Speed :	32-41 MPH
	Number in Pace :	1894
	Percent in Pace :	72.0%
	Number of Vehicles > 35 MPH :	1498
	Percent of Vehicles > 35 MPH :	56.9%
	Mean Speed(Average) :	36 MPH

Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink



123082 B Volume
Site Code: TBA

Start Time	13-Nov-12		14-Nov-12		15-Nov-12		16-Nov-12		17-Nov-12		18-Nov-12		19-Nov-12		Week Average	
	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
12:00 AM	1	4	5	2	5	3	5	5	11	1	9	3	3	3	6	3
01:00	1	2	0	0	0	0	2	0	3	3	5	1	3	2	2	1
02:00	1	0	0	0	1	0	2	1	2	0	4	1	0	2	1	1
03:00	0	1	0	0	1	0	3	2	0	2	4	1	0	0	1	1
04:00	4	3	5	3	4	2	2	5	1	1	0	0	3	4	3	3
05:00	10	19	7	18	9	22	14	22	4	3	1	3	12	22	8	16
06:00	69	119	57	108	72	112	53	108	11	12	10	11	59	106	47	82
07:00	172	324	200	334	172	351	170	317	31	39	18	16	179	342	135	246
08:00	250	298	273	322	236	294	246	263	82	69	36	24	266	303	198	225
09:00	141	164	145	184	119	134	107	112	132	126	41	45	106	156	113	132
10:00	65	67	99	103	86	78	78	77	122	113	56	68	73	62	83	81
11:00	52	84	91	103	72	80	69	90	132	129	48	62	57	81	74	90
12:00 PM	90	68	145	140	101	95	81	86	136	134	79	84	78	99	101	101
01:00	61	58	129	154	67	72	77	77	143	134	77	95	64	89	88	97
02:00	72	117	132	127	84	103	101	101	154	119	79	76	59	111	97	108
03:00	149	242	154	232	147	216	140	238	109	121	67	72	155	214	132	191
04:00	218	359	200	295	202	340	186	289	59	84	65	71	192	297	160	248
05:00	195	392	217	359	205	357	222	292	65	66	49	43	187	321	163	261
06:00	155	226	155	241	143	211	183	115	47	41	28	35	133	254	121	160
07:00	63	86	56	94	58	65	43	51	19	41	24	30	58	85	46	65
08:00	45	30	46	41	42	36	26	37	17	28	20	23	40	39	34	33
09:00	35	37	33	19	26	35	23	27	19	26	12	18	15	22	23	26
10:00	15	14	23	16	26	12	28	19	20	10	8	7	12	13	19	13
11:00	5	3	12	2	11	1	4	13	11	15	8	1	3	4	8	6
Total	1869	2717	2184	2897	1889	2619	1865	2347	1330	1317	748	790	1757	2631	1663	2190
Day	4586		5081		4508		4212		2647		1538		4388		3853	
AM Peak	08:00	07:00	08:00	07:00	08:00	07:00	08:00	07:00	09:00	11:00	10:00	10:00	08:00	07:00	08:00	07:00
Vol.	250	324	273	334	236	351	246	317	132	129	56	68	266	342	198	246
PM Peak	16:00	17:00	17:00	17:00	17:00	17:00	17:00	17:00	14:00	12:00	12:00	13:00	16:00	17:00	17:00	17:00
Vol.	218	392	217	359	205	357	222	292	154	134	79	95	192	321	163	261

Comb. Total	4586	5081	4508	4212	2647	1538	4388	3853
ADT	ADT 3,851	AADT 3,851						

Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink



123082 B Volume
Site Code: TBA

Start	NB		SB		Combined		13-Nov-12
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	Tue
12:00	1	25	2	21	3	46	
12:15	0	22	2	19	2	41	
12:30	0	21	0	15	0	36	
12:45	0	22	0	13	0	35	158
01:00	0	23	1	15	1	38	
01:15	0	6	0	10	0	16	
01:30	1	19	0	20	1	39	
01:45	0	13	1	13	1	26	119
02:00	0	12	0	22	0	34	
02:15	1	15	0	23	1	38	
02:30	0	20	0	32	0	52	
02:45	0	25	0	40	0	65	189
03:00	0	26	0	75	0	101	
03:15	0	39	0	36	0	75	
03:30	0	35	0	61	0	96	
03:45	0	49	1	70	1	119	391
04:00	1	56	0	83	1	139	
04:15	0	55	2	101	2	156	
04:30	1	54	0	101	1	155	
04:45	2	53	1	74	3	127	577
05:00	0	47	0	106	0	153	
05:15	1	43	4	99	5	142	
05:30	3	43	4	107	7	150	
05:45	6	62	11	80	17	142	587
06:00	4	59	8	71	12	130	
06:15	16	47	20	64	36	111	
06:30	15	25	38	50	53	75	
06:45	34	24	53	41	87	65	381
07:00	29	18	68	43	97	61	
07:15	30	18	72	13	102	31	
07:30	50	9	87	12	137	21	
07:45	63	18	97	18	160	36	149
08:00	58	10	84	10	142	20	
08:15	61	13	74	11	135	24	
08:30	66	11	69	6	135	17	
08:45	65	11	71	3	136	14	75
09:00	56	14	49	7	105	21	
09:15	36	7	51	13	87	20	
09:30	24	7	36	10	60	17	
09:45	25	7	28	7	53	14	72
10:00	22	4	24	5	46	9	
10:15	17	8	19	4	36	12	
10:30	11	1	13	3	24	4	
10:45	15	2	11	2	26	4	29
11:00	14	2	15	1	29	3	
11:15	9	1	17	1	26	2	
11:30	14	1	25	0	39	1	
11:45	15	1	27	1	42	2	8
Total	766	1103	1085	1632	1851	2735	
Percent	41.4%	40.3%	58.6%	59.7%			
Day Total	1869		2717		4586		
Peak	08:00	04:00	07:30	05:00	07:30	04:15	
Vol.	250	218	342	392	574	591	
P.H.F.	0.947	0.973	0.881	0.916	0.897	0.947	

Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink



123082 B Volume
Site Code: TBA

Start Time	NB		SB		Combined		14-Nov- 12 Wed
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
12:00	2	34	0	42	2	76	
12:15	1	35	0	31	1	66	
12:30	1	40	1	31	2	71	
12:45	1	36	1	36	2	72	285
01:00	0	30	0	22	0	52	
01:15	0	35	0	56	0	91	
01:30	0	37	0	45	0	82	
01:45	0	27	0	31	0	58	283
02:00	0	34	0	21	0	55	
02:15	0	30	0	26	0	56	
02:30	0	27	0	44	0	71	
02:45	0	41	0	36	0	77	259
03:00	0	34	0	62	0	96	
03:15	0	46	0	67	0	113	
03:30	0	28	0	51	0	79	
03:45	0	46	0	52	0	98	386
04:00	0	44	0	76	0	120	
04:15	1	63	2	62	3	125	
04:30	3	45	1	71	4	116	
04:45	1	48	0	86	1	134	495
05:00	2	65	1	84	3	149	
05:15	1	49	4	116	5	165	
05:30	2	54	4	79	6	133	
05:45	2	49	9	80	11	129	576
06:00	7	55	12	80	19	135	
06:15	13	39	20	61	33	100	
06:30	13	29	30	58	43	87	
06:45	24	32	46	42	70	74	396
07:00	27	12	66	44	93	56	
07:15	48	13	86	17	134	30	
07:30	70	16	88	17	158	33	
07:45	55	15	94	16	149	31	150
08:00	69	13	82	13	151	26	
08:15	68	10	79	12	147	22	
08:30	71	11	78	10	149	21	
08:45	65	12	83	6	148	18	87
09:00	36	8	67	7	103	15	
09:15	33	14	53	9	86	23	
09:30	47	5	42	2	89	7	
09:45	29	6	22	1	51	7	52
10:00	30	4	28	6	58	10	
10:15	19	4	34	4	53	8	
10:30	26	5	16	5	42	10	
10:45	24	10	25	1	49	11	39
11:00	17	4	12	0	29	4	
11:15	26	4	28	1	54	5	
11:30	30	2	27	1	57	3	
11:45	18	2	36	0	54	2	14
Total	882	1302	1177	1720	2059	3022	
Percent	42.8%	43.1%	57.2%	56.9%			
Day Total		2184		2897		5081	
Peak	08:00	04:15	07:15	04:45	07:30	04:45	
Vol.	273	221	350	365	605	581	
P.H.F.	0.961	0.850	0.931	0.787	0.957	0.880	

Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink



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123082 B Volume
Site Code: TBA

Start Time	NB		SB		Combined		15-Nov- 12 Thu
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
12:00	2	20	3	25	5	45	
12:15	0	19	0	25	0	44	
12:30	2	32	0	20	2	52	
12:45	1	30	0	25	1	55	196
01:00	0	16	0	21	0	37	
01:15	0	16	0	15	0	31	
01:30	0	15	0	17	0	32	
01:45	0	20	0	19	0	39	139
02:00	0	17	0	21	0	38	
02:15	1	16	0	32	1	48	
02:30	0	18	0	22	0	40	
02:45	0	33	0	28	0	61	187
03:00	0	40	0	67	0	107	
03:15	1	41	0	37	1	78	
03:30	0	21	0	51	0	72	
03:45	0	45	0	61	0	106	363
04:00	0	51	0	89	0	140	
04:15	0	42	2	82	2	124	
04:30	1	45	0	83	1	128	
04:45	3	64	0	86	3	150	542
05:00	2	41	2	99	4	140	
05:15	0	64	4	83	4	147	
05:30	2	56	9	83	11	139	
05:45	5	44	7	92	12	136	562
06:00	5	40	11	84	16	124	
06:15	16	47	20	51	36	98	
06:30	22	33	26	51	48	84	
06:45	29	23	55	25	84	48	354
07:00	22	14	86	31	108	45	
07:15	43	19	81	21	124	40	
07:30	44	13	77	7	121	20	
07:45	63	12	107	6	170	18	123
08:00	51	7	94	10	145	17	
08:15	75	12	60	6	135	18	
08:30	67	14	81	9	148	23	
08:45	43	9	59	11	102	20	78
09:00	42	9	55	9	97	18	
09:15	24	6	38	14	62	20	
09:30	27	7	21	5	48	12	
09:45	26	4	20	7	46	11	61
10:00	16	7	23	2	39	9	
10:15	19	4	17	5	36	9	
10:30	27	6	19	5	46	11	
10:45	24	9	19	0	43	9	38
11:00	15	7	9	0	24	7	
11:15	18	0	26	1	44	1	
11:30	17	2	18	0	35	2	
11:45	22	2	27	0	49	2	12
Total	777	1112	1076	1543	1853	2655	
Percent	41.9%	41.9%	58.1%	58.1%			
Day Total		1889		2619		4508	
Peak	07:45	04:45	07:15	05:00	07:45	04:45	
Vol.	256	225	359	357	598	576	
P.H.F.	0.853	0.879	0.839	0.902	0.879	0.960	

Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink



123082 B Volume
Site Code: TBA

Start	NB		SB		Combined		16-Nov-12
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	Fri
12:00	0	12	1	24	1	36	
12:15	1	21	1	26	2	47	
12:30	2	31	1	19	3	50	
12:45	2	17	2	17	4	34	167
01:00	1	19	0	16	1	35	
01:15	0	22	0	27	0	49	
01:30	1	15	0	18	1	33	
01:45	0	21	0	16	0	37	154
02:00	0	24	0	17	0	41	
02:15	0	27	0	24	0	51	
02:30	1	21	1	36	2	57	
02:45	1	29	0	24	1	53	202
03:00	0	37	2	72	2	109	
03:15	2	36	0	65	2	101	
03:30	0	35	0	58	0	93	
03:45	1	32	0	43	1	75	378
04:00	0	46	0	56	0	102	
04:15	1	53	2	54	3	107	
04:30	1	44	2	89	3	133	
04:45	0	43	1	90	1	133	475
05:00	2	56	1	94	3	150	
05:15	4	55	3	81	7	136	
05:30	3	60	6	66	9	126	
05:45	5	51	12	51	17	102	514
06:00	7	49	12	32	19	81	
06:15	10	65	15	38	25	103	
06:30	14	41	31	31	45	72	
06:45	22	28	50	14	72	42	298
07:00	32	16	60	25	92	41	
07:15	39	13	70	10	109	23	
07:30	45	8	81	10	126	18	
07:45	54	6	106	6	160	12	94
08:00	54	4	75	15	129	19	
08:15	57	8	65	10	122	18	
08:30	76	8	70	6	146	14	
08:45	59	6	53	6	112	12	63
09:00	40	4	35	8	75	12	
09:15	20	7	35	4	55	11	
09:30	26	5	25	11	51	16	
09:45	21	7	17	4	38	11	50
10:00	27	4	22	3	49	7	
10:15	13	6	21	7	34	13	
10:30	26	9	17	3	43	12	
10:45	12	9	17	6	29	15	47
11:00	22	1	18	2	40	3	
11:15	18	2	21	7	39	9	
11:30	16	0	23	3	39	3	
11:45	13	1	28	1	41	2	17
Total	751	1114	1002	1345	1753	2459	
Percent	42.8%	45.3%	57.2%	54.7%			
Day Total		1865		2347		4212	
Peak	08:00	05:30	07:15	04:30	07:45	04:30	
Vol.	246	225	332	354	557	552	
P.H.F.	0.809	0.865	0.783	0.941	0.870	0.920	



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
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Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

123082 B Volume
Site Code: TBA

Start	NB		SB		Combined		17-Nov-12 Sat
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
12:00	5	33	0	34	5	67	
12:15	3	39	1	29	4	68	
12:30	1	31	0	36	1	67	
12:45	2	33	0	35	2	68	270
01:00	1	35	1	31	2	66	
01:15	0	36	0	34	0	70	
01:30	2	36	2	40	4	76	
01:45	0	36	0	29	0	65	277
02:00	1	38	0	34	1	72	
02:15	0	37	0	30	0	67	
02:30	0	33	0	23	0	56	
02:45	1	46	0	32	1	78	273
03:00	0	32	1	41	1	73	
03:15	0	39	0	29	0	68	
03:30	0	20	0	32	0	52	
03:45	0	18	1	19	1	37	230
04:00	0	18	0	22	0	40	
04:15	1	12	0	22	1	34	
04:30	0	15	0	22	0	37	
04:45	0	14	1	18	1	32	143
05:00	1	16	0	17	1	33	
05:15	2	18	0	19	2	37	
05:30	1	17	0	16	1	33	
05:45	0	14	3	14	3	28	131
06:00	1	12	1	13	2	25	
06:15	3	14	4	9	7	23	
06:30	3	10	4	10	7	20	
06:45	4	11	3	9	7	20	88
07:00	5	5	4	13	9	18	
07:15	6	7	6	7	12	14	
07:30	8	6	16	11	24	17	
07:45	12	1	13	10	25	11	60
08:00	13	8	13	5	26	13	
08:15	23	1	14	11	37	12	
08:30	19	7	18	9	37	16	
08:45	27	1	24	3	51	4	45
09:00	32	7	21	4	53	11	
09:15	28	6	32	12	60	18	
09:30	39	4	30	6	69	10	
09:45	33	2	43	4	76	6	45
10:00	31	3	25	5	56	8	
10:15	28	7	33	0	61	7	
10:30	33	7	30	1	63	8	
10:45	30	3	25	4	55	7	30
11:00	31	3	29	4	60	7	
11:15	38	2	43	3	81	5	
11:30	30	5	33	5	63	10	
11:45	33	1	24	3	57	4	26
Total	531	799	498	819	1029	1618	
Percent	51.6%	49.4%	48.4%	50.6%			
Day Total	1330		1317		2647		
Peak	09:00	02:00	09:30	00:45	09:30	01:15	
Vol.	132	154	131	140	262	283	
P.H.F.	0.846	0.837	0.762	0.875	0.862	0.931	

Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink



PRECISION
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123082 B Volume
Site Code: TBA

Start	NB		SB		Combined		18-Nov-12
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	Sun
12:00	3	19	1	16	4	35	
12:15	5	17	1	19	6	36	
12:30	0	26	0	28	0	54	
12:45	1	17	1	21	2	38	163
01:00	2	26	0	22	2	48	
01:15	1	14	0	30	1	44	
01:30	1	18	0	22	1	40	
01:45	1	19	1	21	2	40	172
02:00	3	17	0	16	3	33	
02:15	0	19	0	22	0	41	
02:30	1	27	0	18	1	45	
02:45	0	16	1	20	1	36	155
03:00	1	14	0	17	1	31	
03:15	1	14	0	22	1	36	
03:30	1	21	0	18	1	39	
03:45	1	18	1	15	2	33	139
04:00	0	18	0	17	0	35	
04:15	0	18	0	16	0	34	
04:30	0	18	0	17	0	35	
04:45	0	11	0	21	0	32	136
05:00	0	15	0	19	0	34	
05:15	1	10	0	7	1	17	
05:30	0	12	1	9	1	21	
05:45	0	12	2	8	2	20	92
06:00	2	8	0	11	2	19	
06:15	1	8	5	7	6	15	
06:30	0	7	5	12	5	19	
06:45	7	5	1	5	8	10	63
07:00	5	5	2	9	7	14	
07:15	4	6	9	6	13	12	
07:30	4	7	4	8	8	15	
07:45	5	6	1	7	6	13	54
08:00	4	9	3	10	7	19	
08:15	6	3	5	4	11	7	
08:30	7	3	6	5	13	8	
08:45	19	5	10	4	29	9	43
09:00	12	4	11	5	23	9	
09:15	12	5	11	5	23	10	
09:30	7	2	10	5	17	7	
09:45	10	1	13	3	23	4	30
10:00	8	2	15	4	23	6	
10:15	11	2	21	1	32	3	
10:30	13	2	15	0	28	2	
10:45	24	2	17	2	41	4	15
11:00	15	5	14	0	29	5	
11:15	10	0	25	0	35	0	
11:30	6	1	7	0	13	1	
11:45	17	2	16	1	33	3	9
Total	232	516	235	555	467	1071	
Percent	49.7%	48.2%	50.3%	51.8%			
Day Total	748		790		1538		
Peak	10:15	00:15	10:30	00:30	10:30	00:30	
Vol.	63	86	71	101	133	184	
P.H.F.	0.656	0.827	0.710	0.842	0.811	0.852	

Bedford Road
south of N.Great Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink



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123082 B Volume
Site Code: TBA

Start	NB		SB		Combined		19-Nov-12
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	Mon
12:00	1	23	2	26	3	49	
12:15	0	18	1	27	1	45	
12:30	1	20	0	20	1	40	
12:45	1	17	0	26	1	43	177
01:00	0	22	1	32	1	54	
01:15	3	13	1	17	4	30	
01:30	0	10	0	21	0	31	
01:45	0	19	0	19	0	38	153
02:00	0	9	0	19	0	28	
02:15	0	20	0	29	0	49	
02:30	0	12	0	34	0	46	
02:45	0	18	2	29	2	47	170
03:00	0	37	0	72	0	109	
03:15	0	43	0	41	0	84	
03:30	0	38	0	57	0	95	
03:45	0	37	0	44	0	81	369
04:00	1	43	0	65	1	108	
04:15	0	50	2	59	2	109	
04:30	1	47	1	80	2	127	
04:45	1	52	1	93	2	145	489
05:00	2	48	2	85	4	133	
05:15	3	40	5	76	8	116	
05:30	3	44	8	93	11	137	
05:45	4	55	7	67	11	122	508
06:00	9	30	13	87	22	117	
06:15	11	57	24	57	35	114	
06:30	8	24	28	69	36	93	
06:45	31	22	41	41	72	63	387
07:00	22	22	67	31	89	53	
07:15	40	16	81	33	121	49	
07:30	51	14	93	13	144	27	
07:45	66	6	101	8	167	14	143
08:00	63	10	87	16	150	26	
08:15	61	8	76	10	137	18	
08:30	77	15	76	8	153	23	
08:45	65	7	64	5	129	12	79
09:00	38	3	69	5	107	8	
09:15	23	3	42	9	65	12	
09:30	24	5	23	6	47	11	
09:45	21	4	22	2	43	6	37
10:00	24	4	20	3	44	7	
10:15	13	3	11	4	24	7	
10:30	24	4	19	3	43	7	
10:45	12	1	12	3	24	4	25
11:00	17	2	12	3	29	5	
11:15	11	0	17	1	28	1	
11:30	8	1	25	0	33	1	
11:45	21	0	27	0	48	0	7
Total	761	996	1083	1548	1844	2544	
Percent	41.3%	39.2%	58.7%	60.8%			
Day Total	1757		2631		4388		
Peak	07:45	04:15	07:15	04:45	07:45	04:45	
Vol.	267	197	362	347	607	531	
P.H.F.	0.867	0.947	0.896	0.933	0.909	0.916	



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Bypass Road
west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

123082 C Class
Site Code: TBA

WB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/13/1														
2	0	19	1	0	0	0	0	0	0	0	0	0	0	20
01:00	0	5	1	0	0	0	0	0	0	1	0	0	0	7
02:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
03:00	0	1	1	0	0	0	0	0	0	0	0	0	0	2
04:00	0	5	0	0	0	0	0	0	0	1	0	0	0	6
05:00	0	36	12	5	0	0	0	1	0	0	0	0	0	54
06:00	1	125	30	2	3	2	0	0	0	0	0	0	0	163
07:00	1	239	27	1	3	4	0	0	2	0	0	0	0	277
08:00	0	246	31	1	4	4	0	1	1	0	0	0	0	288
09:00	2	205	26	1	6	4	0	3	2	0	0	0	0	249
10:00	0	157	24	3	5	5	0	1	2	0	0	0	0	197
11:00	0	162	28	2	3	1	0	4	0	1	0	0	0	201
12 PM	1	179	29	0	8	2	0	1	2	0	0	0	0	222
13:00	1	209	30	1	5	2	0	1	3	0	0	0	0	252
14:00	0	310	36	9	3	2	0	3	2	0	0	0	0	365
15:00	0	418	59	1	13	1	0	1	1	0	0	0	0	494
16:00	3	457	50	3	6	1	0	2	1	0	0	0	0	523
17:00	3	434	44	1	0	1	0	2	0	0	0	0	0	485
18:00	1	525	21	0	3	0	0	1	0	0	0	0	0	551
19:00	1	233	18	0	0	0	0	0	0	0	0	0	0	252
20:00	0	153	4	0	3	0	0	0	0	0	0	0	0	160
21:00	0	111	2	0	1	0	0	0	0	0	0	0	0	114
22:00	0	57	2	0	0	0	0	0	0	0	0	0	0	59
23:00	0	40	3	0	0	0	0	0	0	0	0	0	0	43
Total	14	4328	479	30	66	29	0	21	16	3	0	0	0	4986
Percent	0.3%	86.8%	9.6%	0.6%	1.3%	0.6%	0.0%	0.4%	0.3%	0.1%	0.0%	0.0%	0.0%	
AM Peak	09:00	08:00	08:00	05:00	09:00	10:00		11:00	07:00	01:00				08:00
Vol.	2	246	31	5	6	5		4	2	1				288
PM Peak	16:00	18:00	15:00	14:00	15:00	12:00		14:00	13:00					18:00
Vol.	3	525	59	9	13	2		3	3					551



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123082 C Class
Site Code: TBA

Bypass Road
west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

WB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/14/1														
2	0	9	0	0	0	0	0	0	0	0	0	0	0	9
01:00	0	6	2	0	0	0	0	0	0	0	0	0	0	8
02:00	0	6	0	0	0	0	0	0	0	0	0	0	0	6
03:00	0	6	1	0	0	0	0	0	0	0	0	0	0	7
04:00	0	7	3	0	0	0	0	0	0	0	0	0	0	10
05:00	0	37	11	7	1	0	0	1	0	0	0	0	0	57
06:00	0	119	26	3	8	2	0	3	0	0	0	0	0	161
07:00	1	252	25	3	6	1	0	1	1	0	0	0	0	290
08:00	6	254	37	0	6	0	0	1	1	1	0	0	0	306
09:00	3	196	25	0	5	5	0	1	0	0	0	0	0	235
10:00	0	158	37	2	6	4	0	1	0	0	0	0	0	208
11:00	2	167	35	4	8	3	0	1	3	0	0	0	0	223
12 PM	0	224	31	5	4	3	1	1	2	0	0	0	0	271
13:00	2	221	40	0	12	2	0	4	0	0	0	0	0	281
14:00	0	269	47	9	5	4	0	0	2	0	0	0	0	336
15:00	1	358	59	0	10	1	0	4	1	0	0	0	0	434
16:00	0	472	49	3	6	1	0	1	2	0	0	0	0	534
17:00	1	448	54	0	3	3	0	2	0	0	0	0	0	511
18:00	2	497	35	0	1	0	0	3	0	0	0	0	0	538
19:00	2	288	27	0	5	0	0	0	0	0	0	0	0	322
20:00	1	152	18	0	1	0	0	0	1	0	0	0	0	173
21:00	0	146	9	0	0	0	0	0	0	0	0	0	0	155
22:00	0	89	2	0	0	0	0	0	0	0	0	0	0	91
23:00	0	34	2	0	0	0	0	0	0	0	0	0	0	36
Total	21	4415	575	36	87	29	1	24	13	1	0	0	0	5202
Percent	0.4%	84.9%	11.1%	0.7%	1.7%	0.6%	0.0%	0.5%	0.2%	0.0%	0.0%	0.0%	0.0%	
AM Peak	08:00	08:00	08:00	05:00	06:00	09:00		06:00	11:00	08:00				08:00
Vol.	6	254	37	7	8	5		3	3	1				306
PM Peak	13:00	18:00	15:00	14:00	13:00	14:00	12:00	13:00	12:00					18:00
Vol.	2	497	59	9	12	4	1	4	2					538



PRECISION
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123082 C Class
Site Code: TBA

Bypass Road
west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

WB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/15/1														
2	0	7	1	0	0	0	0	0	0	1	0	0	0	9
01:00	0	7	2	0	0	0	0	0	0	0	0	0	0	9
02:00	0	4	0	0	0	0	0	0	1	0	0	0	0	5
03:00	0	9	2	0	1	0	0	0	0	1	0	0	0	13
04:00	0	6	3	0	2	0	0	0	1	0	0	0	0	12
05:00	0	32	16	7	0	0	0	0	1	0	0	0	0	56
06:00	4	120	27	2	4	1	0	1	1	0	0	0	0	160
07:00	3	266	23	0	10	2	0	2	2	0	0	0	0	308
08:00	3	227	34	5	7	3	1	1	3	0	0	0	0	284
09:00	0	202	36	2	8	4	0	2	2	0	0	0	0	256
10:00	0	159	23	3	6	2	0	0	3	0	0	0	0	196
11:00	1	190	34	3	5	3	1	1	3	0	0	0	0	241
12 PM	0	222	42	2	10	4	2	2	1	1	0	0	0	286
13:00	0	236	38	2	4	4	0	3	3	0	0	0	0	290
14:00	3	266	58	8	12	4	0	2	3	0	0	0	0	356
15:00	2	367	63	4	6	2	0	1	1	0	0	0	0	446
16:00	1	462	54	0	9	0	0	1	3	0	0	0	0	530
17:00	5	513	40	3	4	1	0	1	0	0	0	0	0	567
18:00	5	440	20	1	3	2	0	0	0	0	0	0	0	471
19:00	1	207	20	1	1	0	0	0	0	0	0	0	0	230
20:00	0	179	12	0	2	0	0	0	0	0	0	0	0	193
21:00	0	129	3	0	1	0	0	0	0	0	0	0	0	133
22:00	0	57	4	0	0	0	0	0	0	0	0	0	0	61
23:00	0	37	6	0	0	0	0	0	0	0	0	0	0	43
Total	28	4344	561	43	95	32	4	17	28	3	0	0	0	5155
Percent	0.5%	84.3%	10.9%	0.8%	1.8%	0.6%	0.1%	0.3%	0.5%	0.1%	0.0%	0.0%	0.0%	
AM Peak	06:00	07:00	09:00	05:00	07:00	09:00	08:00	07:00	08:00	00:00				07:00
Vol.	4	266	36	7	10	4	1	2	3	1				308
PM Peak	17:00	17:00	15:00	14:00	14:00	12:00	12:00	13:00	13:00	12:00				17:00
Vol.	5	513	63	8	12	4	2	3	3	1				567



PRECISION
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123082 C Class
Site Code: TBA

Bypass Road
west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

WB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/16/1														
2	0	18	2	0	1	0	0	0	0	0	0	0	0	21
01:00	0	5	3	0	0	0	0	0	0	0	0	0	0	8
02:00	0	4	1	0	0	0	0	0	0	0	0	0	0	5
03:00	0	7	1	0	0	1	0	0	0	0	0	0	0	9
04:00	0	8	0	1	0	0	0	0	0	0	0	0	0	9
05:00	0	30	10	5	1	0	0	1	3	0	0	0	0	50
06:00	1	115	30	2	9	2	0	1	0	0	0	0	0	160
07:00	1	236	30	1	11	0	0	2	2	0	0	0	0	283
08:00	2	228	36	2	10	4	0	2	1	0	0	0	0	285
09:00	0	182	25	1	4	2	0	0	2	0	0	0	0	216
10:00	3	181	27	2	6	1	0	2	3	0	0	0	0	225
11:00	1	215	31	0	11	1	0	1	1	1	0	0	0	262
12 PM	0	217	37	1	6	8	0	1	1	0	0	0	0	271
13:00	2	232	37	2	6	7	0	2	6	0	0	0	0	294
14:00	2	325	50	8	6	3	0	4	0	1	0	0	0	399
15:00	1	425	57	2	6	5	0	3	2	0	0	0	0	501
16:00	1	413	58	1	10	4	0	2	2	0	0	0	0	491
17:00	1	493	37	0	3	0	0	1	1	0	0	0	0	536
18:00	1	358	23	0	4	0	0	0	0	1	0	0	0	387
19:00	0	180	9	0	0	3	0	0	0	0	0	0	0	192
20:00	1	125	12	0	0	0	0	0	0	0	0	0	0	138
21:00	0	107	9	0	0	0	0	0	0	1	0	0	0	117
22:00	2	109	5	0	2	1	0	0	0	0	0	0	0	119
23:00	1	64	5	0	0	0	0	0	0	1	0	0	0	71
Total	20	4277	535	28	96	42	0	22	24	5	0	0	0	5049
Percent	0.4%	84.7%	10.6%	0.6%	1.9%	0.8%	0.0%	0.4%	0.5%	0.1%	0.0%	0.0%	0.0%	
AM Peak	10:00	07:00	08:00	05:00	07:00	08:00		07:00	05:00	11:00				08:00
Vol.	3	236	36	5	11	4		2	3	1				285
PM Peak	13:00	17:00	16:00	14:00	16:00	12:00		14:00	13:00	14:00				17:00
Vol.	2	493	58	8	10	8		4	6	1				536



PRECISION
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INDUSTRIES, LLC

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Bypass Road
west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

123082 C Class
Site Code: TBA

WB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/17/1														
2	0	24	2	0	1	0	0	0	0	0	0	0	0	27
01:00	0	9	3	0	0	0	0	0	0	1	0	0	0	13
02:00	0	6	0	0	0	0	0	0	0	0	0	0	0	6
03:00	0	6	1	0	0	0	0	0	0	0	0	0	0	7
04:00	0	14	1	1	1	0	0	0	0	0	0	0	0	17
05:00	0	11	2	1	0	0	0	0	0	1	0	0	0	15
06:00	0	54	8	1	2	1	0	0	0	0	0	0	0	66
07:00	1	67	5	0	4	3	0	1	1	0	0	0	1	83
08:00	0	122	14	1	1	2	0	0	3	0	0	0	0	143
09:00	1	171	23	1	5	1	0	0	1	0	0	0	0	203
10:00	1	187	23	1	2	1	0	2	1	1	0	0	0	219
11:00	2	215	19	0	9	1	0	4	0	1	0	0	0	251
12 PM	2	247	21	1	7	2	0	0	2	0	0	0	0	282
13:00	1	247	18	0	6	0	0	0	1	0	0	0	0	273
14:00	0	281	27	0	6	0	1	2	1	0	0	0	0	318
15:00	1	273	21	0	4	1	0	1	0	0	0	0	0	301
16:00	1	284	29	0	0	1	0	1	1	0	0	0	0	317
17:00	0	217	17	0	0	0	0	0	1	0	0	0	0	235
18:00	1	152	14	0	1	0	0	0	0	0	0	0	0	168
19:00	0	117	7	0	0	0	0	0	0	0	0	0	0	124
20:00	0	115	6	0	1	0	0	0	0	0	0	0	0	122
21:00	0	102	7	0	0	0	0	0	0	0	0	0	0	109
22:00	0	96	10	0	0	0	0	0	0	0	0	0	0	106
23:00	0	63	6	0	0	0	0	0	0	0	0	0	0	69
Total	11	3080	284	7	50	13	1	11	12	4	0	0	1	3474
Percent	0.3%	88.7%	8.2%	0.2%	1.4%	0.4%	0.0%	0.3%	0.3%	0.1%	0.0%	0.0%	0.0%	
AM Peak	11:00	11:00	09:00	04:00	11:00	07:00		11:00	08:00	01:00			07:00	11:00
Vol.	2	215	23	1	9	3		4	3	1			1	251
PM Peak	12:00	16:00	16:00	12:00	12:00	12:00	14:00	14:00	12:00					14:00
Vol.	2	284	29	1	7	2	1	2	2					318



PRECISION
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Bypass Road
west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

123082 C Class
Site Code: TBA

WB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/18/1														
2	0	29	4	0	0	0	0	0	0	0	0	0	0	33
01:00	0	18	1	0	0	0	0	0	0	0	0	0	0	19
02:00	0	7	1	0	0	0	0	0	0	0	0	0	0	8
03:00	0	3	0	0	1	0	0	0	0	0	0	0	0	4
04:00	0	1	2	0	0	0	0	0	0	0	0	0	0	3
05:00	0	3	6	0	0	0	0	0	0	0	0	0	0	9
06:00	0	34	5	0	1	0	0	0	0	0	0	0	0	40
07:00	0	45	6	0	0	0	0	0	0	0	0	0	0	51
08:00	0	78	5	0	0	0	0	0	0	0	0	0	0	83
09:00	1	115	7	1	3	0	0	0	0	1	0	0	0	128
10:00	1	151	14	0	1	1	0	0	1	0	0	0	0	169
11:00	2	177	12	0	2	0	0	0	0	1	0	0	0	194
12 PM	4	223	15	0	1	0	0	0	0	0	0	0	0	243
13:00	1	242	13	0	1	0	0	0	0	0	0	0	0	257
14:00	0	241	16	0	0	0	0	2	0	0	0	0	0	259
15:00	0	244	15	0	0	0	0	0	0	0	0	0	0	259
16:00	1	267	10	0	0	0	0	0	0	0	0	0	0	278
17:00	0	140	7	0	1	0	0	1	0	0	0	0	0	149
18:00	0	150	13	0	0	0	0	0	0	1	0	0	0	164
19:00	0	107	11	0	2	1	0	0	0	0	0	0	0	121
20:00	0	81	6	0	0	0	0	0	0	0	0	0	0	87
21:00	0	53	1	0	0	0	0	0	1	0	0	0	0	55
22:00	0	33	2	0	0	0	0	0	0	0	0	0	0	35
23:00	0	27	4	0	0	0	0	0	0	0	0	0	0	31
Total	10	2469	176	1	13	2	0	3	2	3	0	0	0	2679
Percent	0.4%	92.2%	6.6%	0.0%	0.5%	0.1%	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	
AM Peak	11:00	11:00	10:00	09:00	09:00	10:00			10:00	09:00				11:00
Vol.	2	177	14	1	3	1			1	1				194
PM Peak	12:00	16:00	14:00		19:00	19:00		14:00	21:00	18:00				16:00
Vol.	4	267	16		2	1		2	1	1				278



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123082 C Class
Site Code: TBA

Bypass Road
west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

WB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/19/1														
2	0	12	0	0	0	0	0	0	0	0	0	0	0	12
01:00	0	8	1	0	0	0	0	0	0	0	0	0	0	9
02:00	0	4	0	0	0	0	0	0	0	0	0	0	0	4
03:00	0	7	0	0	0	0	0	0	0	0	0	0	0	7
04:00	0	3	3	0	1	0	0	0	0	0	0	0	0	7
05:00	1	25	12	6	0	0	0	0	1	0	0	0	0	45
06:00	0	121	29	3	8	3	0	1	1	0	0	0	0	166
07:00	0	243	30	1	6	3	2	2	2	0	0	0	0	289
08:00	4	231	33	3	8	8	1	3	3	0	0	0	0	294
09:00	0	177	32	1	9	6	2	1	2	0	0	0	0	230
10:00	0	132	23	8	11	4	1	0	5	0	0	0	0	184
11:00	0	152	34	2	5	5	1	3	1	1	0	0	0	204
12 PM	1	193	21	1	5	1	1	4	2	0	0	0	0	229
13:00	0	198	30	1	5	6	0	2	3	1	0	0	0	246
14:00	1	272	52	9	10	4	1	1	1	0	0	0	0	351
15:00	2	369	55	2	15	0	1	2	1	0	0	0	0	447
16:00	3	465	49	2	4	0	0	3	1	0	0	0	0	527
17:00	4	532	31	1	3	0	0	0	0	0	0	0	0	571
18:00	1	401	29	0	0	0	0	1	0	0	0	0	0	432
19:00	0	275	16	1	1	0	0	0	0	0	0	0	0	293
20:00	0	134	11	0	2	0	0	0	0	0	0	0	0	147
21:00	0	107	10	0	0	0	0	0	0	1	0	0	0	118
22:00	0	52	6	0	1	0	0	0	0	0	0	0	0	59
23:00	0	40	3	0	0	0	0	0	1	0	0	0	0	44
Total	17	4153	510	41	94	40	10	23	24	3	0	0	0	4915
Percent	0.3%	84.5%	10.4%	0.8%	1.9%	0.8%	0.2%	0.5%	0.5%	0.1%	0.0%	0.0%	0.0%	
AM Peak	08:00	07:00	11:00	10:00	10:00	08:00	07:00	08:00	10:00	11:00				08:00
Vol.	4	243	34	8	11	8	2	3	5	1				294
PM Peak	17:00	17:00	15:00	14:00	15:00	13:00	12:00	12:00	13:00	13:00				17:00
Vol.	4	532	55	9	15	6	1	4	3	1				571
Total		27066	3120	186	501	187	16	121	119	22	0	0	1	31460



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123082 C Class
Site Code: TBA

Bypass Road
west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/13/1														
2	0	8	0	0	1	0	0	0	0	0	0	0	0	9
01:00	0	1	0	0	0	0	0	0	1	0	0	0	0	2
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	5	1	0	0	0	0	0	0	1	0	0	0	7
04:00	0	17	3	0	1	0	0	0	1	0	0	0	0	22
05:00	0	107	18	0	3	2	0	0	2	0	0	0	0	132
06:00	1	235	48	2	8	2	0	2	0	0	0	0	0	298
07:00	1	367	56	7	3	3	1	2	1	0	0	0	0	441
08:00	3	392	81	4	16	1	3	4	0	0	0	0	0	504
09:00	0	273	53	2	12	1	2	0	2	0	0	0	0	345
10:00	0	232	59	1	14	2	1	0	1	0	0	0	0	310
11:00	0	146	43	3	13	1	0	1	2	0	0	0	0	209
12 PM	0	140	46	2	7	0	1	0	1	0	0	0	0	197
13:00	0	109	39	2	8	2	1	1	0	0	0	0	0	162
14:00	0	136	45	2	6	2	0	1	2	0	0	0	0	194
15:00	0	185	51	2	7	1	0	0	0	0	0	0	0	246
16:00	1	193	37	5	7	0	0	0	0	0	0	0	0	243
17:00	2	190	32	1	5	0	0	0	0	0	0	0	0	230
18:00	0	206	33	0	4	0	0	0	0	0	0	0	0	243
19:00	0	116	11	1	0	0	0	1	0	0	0	0	0	129
20:00	0	57	12	0	0	0	0	0	0	0	0	0	0	69
21:00	0	37	11	0	2	0	0	0	0	0	0	0	0	50
22:00	0	26	3	0	0	0	0	0	0	0	0	0	0	29
23:00	0	20	5	0	0	0	0	0	0	0	0	0	0	25
Total	8	3198	687	34	117	17	9	12	13	1	0	0	0	4096
Percent	0.2%	78.1%	16.8%	0.8%	2.9%	0.4%	0.2%	0.3%	0.3%	0.0%	0.0%	0.0%	0.0%	
AM Peak	08:00	08:00	08:00	07:00	08:00	07:00	08:00	08:00	05:00	03:00				08:00
Vol.	3	392	81	7	16	3	3	4	2	1				504
PM Peak	17:00	18:00	15:00	16:00	13:00	13:00	12:00	13:00	14:00					15:00
Vol.	2	206	51	5	8	2	1	1	2					246



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123082 C Class
Site Code: TBA

Bypass Road
west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/14/1														
2	0	3	1	0	0	0	0	0	0	0	0	0	0	4
01:00	0	2	1	0	0	0	0	0	0	0	0	0	0	3
02:00	0	2	2	0	0	0	0	0	0	0	0	0	0	4
03:00	0	4	1	1	0	0	0	0	0	0	0	0	0	6
04:00	0	16	9	0	1	0	0	0	0	0	0	0	0	26
05:00	0	96	18	0	7	1	0	0	1	0	0	0	0	123
06:00	2	213	58	1	26	4	0	2	2	0	0	0	0	308
07:00	1	376	59	6	16	3	0	2	3	0	0	0	0	466
08:00	0	486	72	1	14	2	1	2	0	1	0	0	0	579
09:00	1	400	72	8	19	1	2	2	3	0	0	0	0	508
10:00	2	212	41	2	8	2	1	0	0	0	0	0	0	268
11:00	0	186	44	0	6	2	1	0	1	0	0	0	0	240
12 PM	0	165	41	7	8	1	0	5	2	0	0	0	0	229
13:00	1	161	42	4	8	2	0	3	1	0	0	0	0	222
14:00	2	202	42	5	3	0	0	1	0	0	0	0	0	255
15:00	0	196	43	4	15	0	0	0	0	0	0	0	0	258
16:00	1	207	53	4	6	1	0	4	0	0	0	0	0	276
17:00	1	227	34	0	8	2	0	3	1	0	0	0	0	276
18:00	0	169	40	1	4	1	0	1	0	0	0	0	0	216
19:00	0	108	15	0	0	0	0	0	0	0	0	0	0	123
20:00	0	71	11	0	2	0	0	0	0	0	0	0	0	84
21:00	0	54	7	0	1	0	0	0	0	0	0	0	0	62
22:00	0	34	5	1	0	0	0	1	0	0	0	0	0	41
23:00	0	11	4	0	0	0	0	0	0	0	0	0	0	15
Total	11	3601	715	45	152	22	5	26	14	1	0	0	0	4592
Percent	0.2%	78.4%	15.6%	1.0%	3.3%	0.5%	0.1%	0.6%	0.3%	0.0%	0.0%	0.0%	0.0%	
AM Peak	06:00	08:00	08:00	09:00	06:00	06:00	09:00	06:00	07:00	08:00				08:00
Vol.	2	486	72	8	26	4	2	2	3	1				579
PM Peak	14:00	17:00	16:00	12:00	15:00	13:00		12:00	12:00					16:00
Vol.	2	227	53	7	15	2		5	2					276



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123082 C Class
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Bypass Road
west of Lexington Road (Route 2A)
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Client: Toole Design Group/ C. Fink

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/15/1														
2	0	7	2	0	2	0	0	0	0	0	0	0	0	11
01:00	0	3	1	0	1	0	0	0	0	0	0	0	0	5
02:00	0	4	2	0	0	0	0	0	0	0	0	0	0	6
03:00	0	4	0	0	1	0	0	0	1	0	0	0	0	6
04:00	0	19	7	0	0	0	0	0	0	1	0	0	0	27
05:00	0	99	18	0	6	0	0	0	2	0	0	0	0	125
06:00	1	205	58	2	18	5	0	3	2	0	0	0	0	294
07:00	1	342	53	8	9	1	0	1	1	0	0	0	0	416
08:00	1	497	67	3	14	3	1	1	1	0	0	0	0	588
09:00	0	323	55	0	7	2	1	1	0	1	1	0	0	391
10:00	0	204	32	2	7	3	1	0	2	0	0	0	0	251
11:00	0	196	49	5	2	1	0	1	2	0	0	0	0	256
12 PM	0	194	47	0	4	1	0	1	0	0	0	0	0	247
13:00	0	160	37	2	6	0	1	0	0	0	0	0	0	206
14:00	3	188	52	7	6	2	0	1	1	0	0	0	0	260
15:00	2	203	51	8	8	0	0	1	2	0	0	0	0	275
16:00	1	221	53	4	5	1	0	1	0	0	0	0	0	286
17:00	1	244	45	0	3	0	0	0	0	0	0	0	0	293
18:00	3	217	26	2	4	0	0	1	0	0	0	0	0	253
19:00	0	117	12	0	1	0	0	0	0	0	0	0	0	130
20:00	0	63	15	0	2	1	0	0	1	0	0	0	0	82
21:00	0	53	10	0	0	0	0	0	0	0	0	0	0	63
22:00	0	37	8	0	2	0	0	0	0	0	0	0	0	47
23:00	0	15	6	0	0	0	0	0	0	0	0	0	0	21
Total	13	3615	706	43	108	20	4	12	15	2	1	0	0	4539
Percent	0.3%	79.6%	15.6%	0.9%	2.4%	0.4%	0.1%	0.3%	0.3%	0.0%	0.0%	0.0%	0.0%	
AM Peak	06:00	08:00	08:00	07:00	06:00	06:00	08:00	06:00	05:00	04:00	09:00			08:00
Vol.	1	497	67	8	18	5	1	3	2	1	1			588
PM Peak	14:00	17:00	16:00	15:00	15:00	14:00	13:00	12:00	15:00					17:00
Vol.	3	244	53	8	8	2	1	1	2					293



PRECISION
D A T A
INDUSTRIES, LLC

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123082 C Class
Site Code: TBA

Bypass Road
west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/16/1														
2	0	11	3	0	0	0	0	0	0	0	0	0	0	14
01:00	0	2	0	0	1	0	0	0	0	0	0	0	0	3
02:00	0	3	1	0	0	0	0	0	0	0	0	0	0	4
03:00	0	4	2	0	2	0	0	0	0	0	0	0	0	8
04:00	0	22	5	0	0	0	0	0	1	0	0	0	0	28
05:00	1	91	22	0	3	1	0	0	2	0	0	0	0	120
06:00	1	215	56	2	11	3	0	1	1	0	0	0	0	290
07:00	0	362	62	8	12	1	0	0	2	0	0	0	0	447
08:00	2	436	55	3	12	0	0	3	2	0	0	0	0	513
09:00	0	292	43	4	7	3	0	1	1	0	0	0	0	351
10:00	0	221	54	4	9	2	1	0	1	0	0	0	0	292
11:00	1	178	36	4	7	3	0	0	2	0	0	0	0	231
12 PM	0	205	43	4	7	0	1	2	3	0	0	0	0	265
13:00	0	158	38	2	12	1	0	1	1	0	0	0	0	213
14:00	0	185	40	2	12	0	0	1	2	0	0	0	0	242
15:00	1	233	51	6	4	1	2	2	0	0	0	0	0	300
16:00	1	216	41	3	7	2	0	0	0	0	0	0	0	270
17:00	0	237	40	0	4	1	0	1	0	0	0	0	0	283
18:00	2	207	43	1	6	0	0	0	2	0	0	0	0	261
19:00	0	95	25	0	1	0	0	0	0	0	0	0	0	121
20:00	0	49	9	0	1	0	0	0	0	0	0	0	0	59
21:00	0	46	8	0	1	0	0	0	0	1	0	0	0	56
22:00	1	40	3	0	0	1	0	0	0	0	0	0	0	45
23:00	0	33	4	0	0	0	0	0	0	0	0	0	0	37
Total	10	3541	684	43	119	19	4	12	20	1	0	0	0	4453
Percent	0.2%	79.5%	15.4%	1.0%	2.7%	0.4%	0.1%	0.3%	0.4%	0.0%	0.0%	0.0%	0.0%	
AM Peak	08:00	08:00	07:00	07:00	07:00	06:00	10:00	08:00	05:00					08:00
Vol.	2	436	62	8	12	3	1	3	2					513
PM Peak	18:00	17:00	15:00	15:00	13:00	16:00	15:00	12:00	12:00	21:00				15:00
Vol.	2	237	51	6	12	2	2	2	3	1				300



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123082 C Class
Site Code: TBA

Bypass Road
west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/17/1														
2	0	8	5	0	0	0	0	0	1	0	0	0	0	14
01:00	0	9	0	0	1	0	0	0	0	0	0	0	0	10
02:00	0	6	1	0	0	0	0	0	0	0	0	0	0	7
03:00	0	2	2	0	1	0	0	0	2	0	0	0	0	7
04:00	0	3	3	0	0	0	0	0	0	0	0	0	0	6
05:00	0	22	5	0	0	0	0	0	0	0	0	0	0	27
06:00	0	53	12	0	7	0	0	0	2	0	0	0	0	74
07:00	0	97	26	0	6	1	1	1	3	0	0	0	0	135
08:00	0	142	33	1	8	1	0	2	1	0	0	0	0	188
09:00	2	167	31	0	6	4	0	2	1	0	0	0	0	213
10:00	1	203	25	2	5	1	0	1	0	0	0	0	0	238
11:00	0	208	52	1	5	1	0	0	0	0	0	0	0	267
12 PM	1	218	44	0	8	0	0	1	1	0	0	0	0	273
13:00	1	183	48	1	3	0	0	1	0	0	1	0	0	238
14:00	1	227	44	0	7	0	0	1	0	0	0	0	0	280
15:00	1	202	43	2	4	0	0	0	0	0	0	0	0	252
16:00	2	173	29	0	4	0	0	2	0	0	0	0	0	210
17:00	3	155	30	0	1	0	0	0	0	0	0	0	0	189
18:00	0	134	15	0	2	0	0	1	0	0	0	0	0	152
19:00	0	66	24	0	3	0	0	0	0	0	0	0	0	93
20:00	0	60	10	0	1	0	0	0	0	0	0	0	0	71
21:00	0	39	8	0	1	0	0	0	0	0	0	0	0	48
22:00	0	40	10	0	1	0	0	0	0	0	0	0	0	51
23:00	0	35	4	0	2	0	0	0	0	0	0	0	0	41
Total	12	2452	504	7	76	8	1	12	11	0	1	0	0	3084
Percent	0.4%	79.5%	16.3%	0.2%	2.5%	0.3%	0.0%	0.4%	0.4%	0.0%	0.0%	0.0%	0.0%	
AM Peak	09:00	11:00	11:00	10:00	08:00	09:00	07:00	08:00	07:00					11:00
Vol.	2	208	52	2	8	4	1	2	3					267
PM Peak	17:00	14:00	13:00	15:00	12:00			16:00	12:00		13:00			14:00
Vol.	3	227	48	2	8			2	1		1			280



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Bypass Road
west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

123082 C Class
Site Code: TBA

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/18/1														
2	0	14	5	0	0	0	0	0	0	0	0	0	0	19
01:00	0	9	2	0	0	0	0	0	0	0	0	0	0	11
02:00	0	6	0	0	0	0	0	0	0	0	0	0	0	6
03:00	0	2	2	0	0	0	0	0	0	0	0	0	0	4
04:00	0	4	2	0	0	0	0	0	0	0	0	0	0	6
05:00	0	12	2	0	0	0	0	0	2	0	0	0	0	16
06:00	0	33	3	0	1	0	0	0	0	1	0	0	0	38
07:00	0	49	11	0	0	0	0	0	0	0	0	0	0	60
08:00	0	111	26	0	2	0	0	0	0	0	0	0	0	139
09:00	0	144	25	1	1	0	0	0	0	0	0	0	0	171
10:00	0	170	34	0	3	0	0	0	0	0	0	0	0	207
11:00	0	169	28	1	2	0	0	0	0	0	0	0	0	200
12 PM	3	198	33	0	0	0	0	1	1	0	0	0	0	236
13:00	1	172	46	0	1	0	0	0	0	0	0	0	0	220
14:00	1	195	27	0	3	1	0	0	0	0	0	0	0	227
15:00	2	186	31	0	2	0	0	1	0	0	0	0	0	222
16:00	0	146	34	0	3	1	0	0	0	0	0	0	0	184
17:00	0	114	17	0	3	0	0	0	0	0	0	0	0	134
18:00	0	77	12	0	2	0	0	1	0	0	0	0	0	92
19:00	1	40	12	0	1	0	0	0	0	0	0	0	0	54
20:00	0	54	4	0	0	1	0	0	0	0	0	0	0	59
21:00	0	32	5	0	0	0	0	0	0	0	0	0	0	37
22:00	0	30	4	0	0	0	0	0	0	0	0	0	0	34
23:00	1	6	3	0	3	0	0	0	0	0	0	0	0	13
Total	9	1973	368	2	27	3	0	3	3	1	0	0	0	2389
Percent	0.4%	82.6%	15.4%	0.1%	1.1%	0.1%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	
AM Peak		10:00	10:00	09:00	10:00				05:00	06:00				10:00
Vol.		170	34	1	3				2	1				207
PM Peak	12:00	12:00	13:00		14:00	14:00		12:00	12:00					12:00
Vol.	3	198	46		3	1		1	1					236



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123082 C Class
Site Code: TBA

Bypass Road
west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/19/1														
2	0	2	3	0	1	0	0	0	0	0	0	0	0	6
01:00	0	4	1	0	0	0	0	0	0	0	0	0	0	5
02:00	0	0	1	0	0	0	0	0	0	0	0	0	0	1
03:00	0	5	1	0	0	0	0	0	0	0	0	0	0	6
04:00	0	14	5	0	1	0	0	0	1	0	0	0	0	21
05:00	0	83	24	0	7	0	0	0	2	0	0	0	0	116
06:00	1	217	53	4	12	2	3	1	0	0	0	0	0	293
07:00	1	355	63	6	12	2	0	1	2	0	0	0	0	442
08:00	1	492	73	1	17	2	2	5	3	0	0	0	0	596
09:00	0	341	52	1	5	0	1	0	0	1	0	0	0	401
10:00	0	188	36	1	14	7	3	0	0	0	0	0	0	249
11:00	0	140	45	3	13	5	1	0	2	0	0	0	0	209
12 PM	2	171	41	1	5	3	2	1	3	0	0	0	0	229
13:00	1	132	38	3	6	2	3	1	0	0	0	0	0	186
14:00	1	174	41	1	9	3	0	3	1	0	0	0	0	233
15:00	0	199	55	6	14	3	0	2	0	0	0	0	0	279
16:00	6	185	49	3	7	1	0	2	0	0	0	0	0	253
17:00	3	216	43	0	9	0	0	1	1	0	0	0	0	273
18:00	1	168	31	1	4	0	0	0	0	0	0	0	0	205
19:00	0	107	12	0	1	1	0	0	0	0	0	0	0	121
20:00	0	54	10	0	0	0	1	0	0	0	0	0	0	65
21:00	0	43	8	0	3	0	0	0	0	0	0	0	0	54
22:00	0	33	3	0	1	0	0	0	0	0	0	0	0	37
23:00	0	24	7	0	0	0	0	0	0	0	0	0	0	31
Total	17	3347	695	31	141	31	16	17	15	1	0	0	0	4311
Percent	0.4%	77.6%	16.1%	0.7%	3.3%	0.7%	0.4%	0.4%	0.3%	0.0%	0.0%	0.0%	0.0%	
AM Peak	06:00	08:00	08:00	07:00	08:00	10:00	06:00	08:00	08:00	09:00				08:00
Vol.	1	492	73	6	17	7	3	5	3	1				596
PM Peak	16:00	17:00	15:00	15:00	15:00	12:00	13:00	14:00	12:00					15:00
Vol.	6	216	55	6	14	3	3	3	3					279
Total		21727	4359	205	740	120	39	94	91	7	2	0	0	27464



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Bypass Road
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123082 C Speed
Site Code: TBA

WB

Start Time	14	15	20	25	30	35	40	45	50	55	60	65	70	Total	85th % ile	Ave Speed
11/13/1																
2	0	0	0	0	1	9	8	2	0	0	0	0	0	20	43	40
01:00	0	0	0	0	1	0	3	1	2	0	0	0	0	7	42	44
02:00	0	0	0	0	1	1	0	0	0	0	0	0	0	2	*	34
03:00	0	0	0	0	0	0	1	0	1	0	0	0	0	2	*	47
04:00	0	0	0	0	0	2	1	2	0	0	1	0	0	6	*	45
05:00	0	0	0	1	2	9	29	11	2	0	0	0	0	54	45	42
06:00	0	0	0	2	6	40	85	26	4	0	0	0	0	163	45	41
07:00	0	2	2	3	14	109	118	28	1	0	0	0	0	277	43	39
08:00	0	0	0	3	25	129	119	11	1	0	0	0	0	288	42	39
09:00	0	3	3	5	18	118	91	11	0	0	0	0	0	249	42	38
10:00	0	0	2	5	8	88	75	18	1	0	0	0	0	197	43	39
11:00	0	0	0	3	12	54	97	30	5	0	0	0	0	201	45	41
12 PM	0	3	2	3	16	80	87	28	3	0	0	0	0	222	44	39
13:00	0	0	0	0	17	114	98	22	0	1	0	0	0	252	43	40
14:00	0	0	8	0	14	171	150	21	1	0	0	0	0	365	43	39
15:00	2	3	6	1	34	222	203	22	1	0	0	0	0	494	42	39
16:00	39	24	55	80	90	163	68	4	0	0	0	0	0	523	38	29
17:00	58	9	33	10	65	219	79	10	2	0	0	0	0	485	39	30
18:00	1	1	5	21	93	282	133	15	0	0	0	0	0	551	41	37
19:00	3	1	2	1	17	112	99	17	0	0	0	0	0	252	43	38
20:00	0	0	1	1	7	61	74	15	1	0	0	0	0	160	43	40
21:00	0	0	1	2	7	52	40	11	0	1	0	0	0	114	43	39
22:00	0	0	0	0	1	14	38	4	2	0	0	0	0	59	44	41
23:00	0	0	0	0	0	17	15	7	3	1	0	0	0	43	46	42

%	2.1%	0.9%	2.4%	2.8%	9.0%	41.4%	34.3%	6.3%	0.6%	0.1%	0.0%	0.0%	0.0%			
AM Peak Vol.		09:00	09:00	09:00	08:00	08:00	08:00	07:00	06:00		04:00			08:00		
		3	3	5	25	129	119	28	4		1			288		
Midday Peak Vol.		12:00	14:00	11:00	13:00	14:00	14:00	11:00	11:00	13:00				14:00		
		3	8	3	17	171	150	30	5	1				365		
PM Peak Vol.	17:00	16:00	16:00	16:00	18:00	18:00	15:00	15:00	23:00	21:00				18:00		
	58	24	55	80	93	282	203	22	3	1				551		
% ile			15th Percentile :			31 MPH										
			50th Percentile :			37 MPH										
			85th Percentile :			42 MPH										
			95th Percentile :			45 MPH										

Stats

10 MPH Pace Speed : 35-44 MPH

Number in Pace : 3352

Percent in Pace : 67.2%

Number of Vehicles > 40 MPH : 1701

Percent of Vehicles > 40 MPH : 34.1%

Mean Speed(Average) : 37 MPH



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123082 C Speed
Site Code: TBA

WB

Start Time	14	15	20	25	30	35	40	45	50	55	60	65	70	Total	85th % ile	Ave Speed
11/14/1																
2	0	0	0	0	0	2	5	2	0	0	0	0	0	9	44	42
01:00	0	0	0	0	0	2	4	2	0	0	0	0	0	8	43	42
02:00	0	0	0	0	0	4	0	0	1	1	0	0	0	6	37	43
03:00	0	0	0	0	1	3	2	1	0	0	0	0	0	7	38	39
04:00	0	0	0	0	0	1	6	3	0	0	0	0	0	10	45	43
05:00	0	0	0	0	0	11	30	12	4	0	0	0	0	57	46	43
06:00	0	0	1	0	7	33	66	43	10	1	0	0	0	161	47	42
07:00	0	3	3	5	5	54	143	67	8	1	0	0	1	290	46	42
08:00	4	1	4	6	12	96	132	44	7	0	0	0	0	306	44	40
09:00	0	3	4	10	18	85	97	17	1	0	0	0	0	235	43	38
10:00	2	2	0	1	8	78	96	21	0	0	0	0	0	208	43	39
11:00	0	1	0	2	17	89	96	18	0	0	0	0	0	223	43	39
12 PM	0	2	4	3	12	87	131	31	0	1	0	0	0	271	44	40
13:00	0	0	0	0	18	77	143	37	5	1	0	0	0	281	44	41
14:00	1	5	3	6	27	109	144	38	3	0	0	0	0	336	44	39
15:00	0	0	2	4	25	147	210	45	1	0	0	0	0	434	44	40
16:00	0	0	2	6	31	169	266	60	0	0	0	0	0	534	44	40
17:00	0	0	1	19	71	233	159	27	1	0	0	0	0	511	42	38
18:00	0	0	0	2	56	269	179	28	4	0	0	0	0	538	42	39
19:00	0	0	0	1	13	97	153	57	1	0	0	0	0	322	45	41
20:00	0	0	0	0	1	46	94	31	0	1	0	0	0	173	45	42
21:00	0	0	0	0	1	33	84	32	4	1	0	0	0	155	45	42
22:00	0	0	0	1	0	19	51	17	2	0	1	0	0	91	45	42
23:00	0	0	0	1	0	1	21	10	2	1	0	0	0	36	47	44

%	0.1%	0.3%	0.5%	1.3%	6.2%	33.5%	44.4%	12.4%	1.0%	0.2%	0.0%	0.0%	0.0%			
AM Peak Vol.	08:00	07:00	08:00	09:00	09:00	08:00	07:00	07:00	06:00	02:00				07:00	08:00	
	4	3	4	10	18	96	143	67	10	1				1	306	
Midday Peak Vol.	14:00	14:00	12:00	14:00	14:00	14:00	14:00	14:00	13:00	12:00					14:00	
	1	5	4	6	27	109	144	38	5	1					336	
PM Peak Vol.			15:00	17:00	17:00	18:00	16:00	16:00	18:00	20:00	22:00				18:00	
			2	19	71	269	266	60	4	1	1				538	
% ile			15th Percentile :			34 MPH										
			50th Percentile :			39 MPH										
			85th Percentile :			44 MPH										
			95th Percentile :			47 MPH										

Stats

10 MPH Pace Speed : 36-45 MPH

Number in Pace : 3703

Percent in Pace : 71.2%

Number of Vehicles > 40 MPH : 2526

Percent of Vehicles > 40 MPH : 48.6%

Mean Speed(Average) : 40 MPH



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

Bypass Road
west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

123082 C Speed
Site Code: TBA

WB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/15/1																
2	0	0	0	0	0	2	5	1	1	0	0	0	0	9	43	43
01:00	0	0	0	0	0	2	5	2	0	0	0	0	0	9	44	42
02:00	0	0	0	0	1	2	1	1	0	0	0	0	0	5	*	39
03:00	0	0	0	0	0	5	5	2	1	0	0	0	0	13	44	42
04:00	0	0	0	0	1	3	4	3	1	0	0	0	0	12	46	42
05:00	0	0	0	0	0	10	23	20	2	1	0	0	0	56	47	44
06:00	0	0	1	1	2	25	81	46	4	0	0	0	0	160	46	43
07:00	2	3	3	17	52	115	94	20	2	0	0	0	0	308	42	37
08:00	1	5	7	28	51	127	52	12	1	0	0	0	0	284	41	35
09:00	1	1	4	3	38	95	89	25	0	0	0	0	0	256	43	38
10:00	4	2	3	13	37	68	60	8	1	0	0	0	0	196	42	36
11:00	0	1	4	7	18	111	85	15	0	0	0	0	0	241	42	38
12 PM	1	1	2	11	30	104	124	12	1	0	0	0	0	286	42	38
13:00	0	0	5	10	38	110	103	22	2	0	0	0	0	290	43	38
14:00	5	2	6	30	89	118	101	4	1	0	0	0	0	356	41	35
15:00	3	8	47	61	114	153	58	2	0	0	0	0	0	446	39	33
16:00	0	2	6	4	36	228	212	38	3	1	0	0	0	530	43	39
17:00	6	4	4	18	57	270	179	25	4	0	0	0	0	567	42	37
18:00	0	1	1	0	42	191	197	35	4	0	0	0	0	471	43	39
19:00	0	0	0	0	7	70	121	31	1	0	0	0	0	230	44	41
20:00	0	0	0	1	3	68	84	33	3	1	0	0	0	193	45	41
21:00	0	0	0	0	2	36	69	25	1	0	0	0	0	133	45	42
22:00	0	0	0	1	1	18	26	14	0	1	0	0	0	61	46	42
23:00	0	0	0	0	0	11	15	14	3	0	0	0	0	43	47	43

%	0.4%	0.6%	1.8%	4.0%	12.0%	37.7%	34.8%	8.0%	0.7%	0.1%	0.0%	0.0%	0.0%
AM Peak Vol.	07:00	08:00	08:00	08:00	07:00	08:00	07:00	06:00	06:00	05:00	07:00		
	2	5	7	28	52	127	94	46	4	1	308		
Midday Peak Vol.	14:00	14:00	14:00	14:00	14:00	14:00	12:00	13:00	13:00	14:00			
	5	2	6	30	89	118	124	22	2	356			
PM Peak Vol.	17:00	15:00	15:00	15:00	15:00	17:00	16:00	16:00	17:00	16:00	17:00		
	6	8	47	61	114	270	212	38	4	1	567		
% ile			15th Percentile :			32 MPH							
			50th Percentile :			38 MPH							
			85th Percentile :			43 MPH							
			95th Percentile :			46 MPH							

Stats

10 MPH Pace Speed :	35-44 MPH
Number in Pace :	3390
Percent in Pace :	65.8%
Number of Vehicles > 40 MPH :	1879
Percent of Vehicles > 40 MPH :	36.5%
Mean Speed(Average) :	38 MPH



PRECISION
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Bypass Road
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123082 C Speed
Site Code: TBA

WB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/16/1																
2	0	0	0	0	3	6	8	4	0	0	0	0	0	21	45	40
01:00	0	0	0	0	1	1	3	2	0	1	0	0	0	8	43	43
02:00	0	0	0	0	0	1	4	0	0	0	0	0	0	5	42	41
03:00	0	0	0	0	1	1	5	2	0	0	0	0	0	9	44	41
04:00	0	0	0	0	0	0	3	5	1	0	0	0	0	9	48	46
05:00	0	0	0	0	0	7	24	18	0	1	0	0	0	50	46	43
06:00	0	1	2	0	3	32	77	39	6	0	0	0	0	160	46	42
07:00	0	2	0	3	14	109	115	35	4	1	0	0	0	283	44	40
08:00	0	0	0	0	25	93	143	21	3	0	0	0	0	285	43	40
09:00	0	2	1	3	8	59	111	32	0	0	0	0	0	216	44	40
10:00	0	1	2	3	15	88	86	28	2	0	0	0	0	225	44	40
11:00	0	0	2	2	19	96	124	18	1	0	0	0	0	262	43	40
12 PM	0	1	0	5	20	116	106	21	2	0	0	0	0	271	43	39
13:00	0	1	2	6	23	124	115	22	1	0	0	0	0	294	43	39
14:00	0	1	2	4	36	159	177	18	2	0	0	0	0	399	43	39
15:00	1	2	5	21	59	238	149	23	3	0	0	0	0	501	42	38
16:00	0	0	4	5	45	190	215	28	4	0	0	0	0	491	43	39
17:00	0	1	2	5	73	243	183	28	1	0	0	0	0	536	42	38
18:00	1	0	0	8	38	152	160	27	0	0	1	0	0	387	43	39
19:00	0	0	0	0	2	44	101	41	4	0	0	0	0	192	45	42
20:00	0	0	0	2	5	40	70	18	3	0	0	0	0	138	44	41
21:00	0	0	1	2	3	29	59	21	1	1	0	0	0	117	45	41
22:00	0	0	0	1	4	24	65	23	2	0	0	0	0	119	45	42
23:00	0	0	0	2	5	22	31	10	1	0	0	0	0	71	44	40

%	0.0%	0.2%	0.5%	1.4%	8.0%	37.1%	42.3%	9.6%	0.8%	0.1%	0.0%	0.0%	0.0%			
AM Peak Vol.		07:00	06:00	07:00	08:00	07:00	08:00	06:00	06:00	01:00				08:00		
		2	2	3	25	109	143	39	6	1				285		
Midday Peak Vol.		12:00	11:00	13:00	14:00	14:00	14:00	13:00	12:00					14:00		
		1	2	6	36	159	177	22	2					399		
PM Peak Vol.	15:00	15:00	15:00	15:00	17:00	17:00	16:00	19:00	16:00	21:00	18:00			17:00		
	1	2	5	21	73	243	215	41	4	1	1			536		

% ile	15th Percentile :	34 MPH
	50th Percentile :	39 MPH
	85th Percentile :	43 MPH
	95th Percentile :	46 MPH

Stats	10 MPH Pace Speed :	35-44 MPH
	Number in Pace :	3628
	Percent in Pace :	71.9%
	Number of Vehicles > 40 MPH :	2224
	Percent of Vehicles > 40 MPH :	44.0%
	Mean Speed(Average) :	40 MPH



PRECISION
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Client: Toole Design Group/ C. Fink

123082 C Speed
Site Code: TBA

WB

Start Time	14	15	20	25	30	35	40	45	50	55	60	65	70	Total	85th % ile	Ave Speed
11/17/1																
2	0	0	0	0	1	5	10	9	2	0	0	0	0	27	47	43
01:00	0	0	0	0	1	3	5	4	0	0	0	0	0	13	46	42
02:00	0	1	0	1	0	1	3	0	0	0	0	0	0	6	41	33
03:00	0	0	0	0	0	2	2	3	0	0	0	0	0	7	46	43
04:00	0	0	0	0	1	0	8	5	2	1	0	0	0	17	48	45
05:00	0	0	0	0	0	2	8	3	2	0	0	0	0	15	47	44
06:00	0	0	0	0	2	17	24	19	3	0	1	0	0	66	47	43
07:00	0	0	1	0	4	20	41	14	3	0	0	0	0	83	45	41
08:00	0	0	0	0	4	41	73	22	3	0	0	0	0	143	44	41
09:00	0	1	1	1	10	53	100	34	3	0	0	0	0	203	45	41
10:00	0	0	0	5	11	82	88	30	3	0	0	0	0	219	44	40
11:00	0	0	0	3	14	80	118	34	2	0	0	0	0	251	44	40
12 PM	0	1	0	7	11	91	143	27	2	0	0	0	0	282	43	40
13:00	0	0	1	1	15	96	134	26	0	0	0	0	0	273	43	40
14:00	0	1	2	3	23	126	135	24	4	0	0	0	0	318	43	39
15:00	0	0	1	2	9	113	152	22	2	0	0	0	0	301	43	40
16:00	0	0	3	1	21	91	155	43	3	0	0	0	0	317	44	40
17:00	0	0	0	1	15	85	109	25	0	0	0	0	0	235	43	40
18:00	0	0	0	2	3	51	89	21	2	0	0	0	0	168	44	41
19:00	0	1	0	1	6	24	63	28	1	0	0	0	0	124	45	41
20:00	0	1	0	1	1	40	57	18	4	0	0	0	0	122	45	41
21:00	0	0	0	0	6	29	55	17	2	0	0	0	0	109	44	41
22:00	0	0	0	2	3	25	60	15	1	0	0	0	0	106	44	41
23:00	0	0	0	0	3	20	30	14	2	0	0	0	0	69	45	41

%	0.0%	0.2%	0.3%	0.9%	4.7%	31.6%	47.8%	13.2%	1.3%	0.0%	0.0%	0.0%	0.0%			
AM Peak Vol.		02:00	07:00	02:00	09:00	09:00	09:00	09:00	06:00	04:00	06:00			09:00		
		1	1	1	10	53	100	34	3	1	1			203		
Midday Peak Vol.		12:00	14:00	12:00	14:00	14:00	12:00	11:00	14:00					14:00		
		1	2	7	23	126	143	34	4					318		
PM Peak Vol.		19:00	16:00	15:00	16:00	15:00	16:00	16:00	20:00					16:00		
		1	3	2	21	113	155	43	4					317		
% ile			15th Percentile :			35 MPH										
			50th Percentile :			40 MPH										
			85th Percentile :			44 MPH										
			95th Percentile :			47 MPH										

Stats

10 MPH Pace Speed : 36-45 MPH

Number in Pace : 2543

Percent in Pace : 73.2%

Number of Vehicles > 40 MPH : 1810

Percent of Vehicles > 40 MPH : 52.1%

Mean Speed(Average) : 40 MPH



PRECISION
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123082 C Speed
Site Code: TBA

WB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
11/18/1																												
2	0	0	0	0	1	1	11	14	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33	45	41
01:00	0	0	0	0	1	0	5	9	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	45	41
02:00	0	0	0	0	0	0	2	1	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	48	45
03:00	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	*	44
04:00	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	*	39
05:00	0	0	0	0	0	0	0	5	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	46	45
06:00	0	0	0	0	0	4	4	17	11	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	48	43
07:00	0	1	0	1	2	8	22	11	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	51	49	42
08:00	0	0	0	0	1	15	40	21	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	83	47	43
09:00	0	0	2	0	5	18	56	38	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	128	47	43
10:00	1	0	0	0	2	32	82	45	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	169	46	42
11:00	1	0	4	0	8	51	83	43	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	194	46	41
12 PM	0	0	1	1	2	56	120	57	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	243	46	42
13:00	0	0	0	1	6	51	130	63	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	257	46	42
14:00	0	0	1	2	9	44	134	63	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	259	46	42
15:00	0	0	1	3	6	53	137	56	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	259	45	42
16:00	0	0	0	5	16	82	137	32	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	278	44	40
17:00	0	0	0	0	7	49	72	18	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	149	44	41
18:00	0	0	0	0	3	44	99	16	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	164	44	41
19:00	0	0	0	1	2	27	75	12	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	121	44	41
20:00	0	1	1	1	2	14	51	16	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	87	45	41
21:00	0	0	0	0	0	16	27	10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	55	45	42
22:00	0	0	0	0	0	7	16	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	46	43
23:00	0	0	0	1	0	7	16	5	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	45	42

%	0.1%	0.1%	0.4%	0.7%	2.8%	22.3%	50.2%	20.4%	2.8%	0.2%	0.0%	0.0%	0.0%															
AM Peak		07:00	09:00	00:00	09:00	09:00	09:00	09:00	09:00	07:00																09:00		
Vol.		1	2	1	5	18	56	38	9	3																128		
Midday Peak	11:00		11:00	14:00	14:00	12:00	14:00	13:00	12:00																	14:00		
Vol.	1		4	2	9	56	134	63	6																	259		
PM Peak		20:00	15:00	16:00	16:00	16:00	15:00	15:00	16:00	18:00																16:00		
Vol.		1	1	5	16	82	137	56	6	1																278		
% ile			15th Percentile :				36 MPH																					
			50th Percentile :				41 MPH																					
			85th Percentile :				46 MPH																					
			95th Percentile :				49 MPH																					

Stats

10 MPH Pace Speed : 37-46 MPH

Number in Pace : 1922

Percent in Pace : 71.7%

Number of Vehicles > 40 MPH : 1672

Percent of Vehicles > 40 MPH : 62.4%

Mean Speed(Average) : 42 MPH



PRECISION
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123082 C Speed
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west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

WB

Start Time	14	15	20	25	30	35	40	45	50	55	60	65	70	Total	85th % ile	Ave Speed
11/19/1																
2	0	0	0	0	1	2	3	6	0	0	0	0	0	12	47	43
01:00	0	0	0	0	0	2	1	6	0	0	0	0	0	9	48	44
02:00	0	0	0	0	0	0	4	0	0	0	0	0	0	4	42	42
03:00	0	0	0	0	0	1	1	4	1	0	0	0	0	7	48	46
04:00	0	0	0	0	0	0	2	2	3	0	0	0	0	7	51	48
05:00	0	0	0	0	0	6	21	13	5	0	0	0	0	45	48	44
06:00	0	0	1	1	5	18	76	54	11	0	0	0	0	166	47	43
07:00	0	0	1	3	10	85	123	59	8	0	0	0	0	289	46	41
08:00	0	3	1	0	7	97	144	34	8	0	0	0	0	294	44	40
09:00	1	1	2	0	4	55	120	43	4	0	0	0	0	230	45	41
10:00	0	1	1	1	4	31	95	47	4	0	0	0	0	184	46	42
11:00	0	0	0	1	9	47	104	39	4	0	0	0	0	204	45	41
12 PM	0	0	1	1	7	54	110	51	5	0	0	0	0	229	46	42
13:00	0	0	4	2	4	66	127	40	2	1	0	0	0	246	44	41
14:00	0	0	1	2	14	86	185	56	7	0	0	0	0	351	45	41
15:00	0	0	0	2	18	145	212	67	2	1	0	0	0	447	44	41
16:00	2	1	0	8	40	187	233	48	6	2	0	0	0	527	43	40
17:00	0	2	3	0	40	271	211	42	2	0	0	0	0	571	43	39
18:00	0	1	0	5	23	183	189	28	3	0	0	0	0	432	43	39
19:00	0	0	0	5	13	103	130	37	4	1	0	0	0	293	44	40
20:00	0	0	0	2	8	35	71	30	1	0	0	0	0	147	45	41
21:00	0	0	0	0	2	23	64	26	3	0	0	0	0	118	45	42
22:00	0	0	0	0	2	20	24	9	3	1	0	0	0	59	46	41
23:00	0	0	0	0	2	13	14	10	4	1	0	0	0	44	48	42

%	0.1%	0.2%	0.3%	0.7%	4.3%	31.1%	46.1%	15.3%	1.8%	0.1%	0.0%	0.0%	0.0%			
AM Peak Vol.	09:00	08:00	09:00	07:00	07:00	08:00	08:00	07:00	06:00					08:00		
	1	3	2	3	10	97	144	59	11					294		
Midday Peak Vol.			13:00	13:00	14:00	14:00	14:00	14:00	14:00	13:00				14:00		
			4	2	14	86	185	56	7	1				351		
PM Peak Vol.	16:00	17:00	17:00	16:00	16:00	17:00	16:00	15:00	16:00	16:00				17:00		
	2	2	3	8	40	271	233	67	6	2				571		
% ile			15th Percentile :			35 MPH										
			50th Percentile :			40 MPH										
			85th Percentile :			45 MPH										
			95th Percentile :			48 MPH										

Stats

10 MPH Pace Speed : 36-45 MPH

Number in Pace : 3520

Percent in Pace : 71.6%

Number of Vehicles > 40 MPH : 2626

Percent of Vehicles > 40 MPH : 53.4%

Mean Speed(Average) : 41 MPH



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

123082 C Speed
Site Code: TBA

Bypass Road
west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

EB

Start Time	14	15	20	25	30	35	40	45	50	55	60	65	70	Total	85th % ile	Ave Speed
11/13/1																
2	0	0	0	0	0	2	4	2	1	0	0	0	0	9	43	43
01:00	0	0	0	0	0	0	0	1	1	0	0	0	0	2	*	49
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
03:00	0	0	0	0	0	1	2	2	1	1	0	0	0	7	*	46
04:00	0	0	0	0	1	2	7	7	5	0	0	0	0	22	51	45
05:00	0	0	1	0	2	9	51	55	14	0	0	0	0	132	48	44
06:00	0	0	1	8	15	48	117	90	17	2	0	0	0	298	47	42
07:00	0	0	0	4	37	133	179	77	11	0	0	0	0	441	45	41
08:00	0	0	0	3	43	145	201	90	19	3	0	0	0	504	45	41
09:00	1	2	2	9	21	73	126	74	31	5	1	0	0	345	48	42
10:00	0	0	0	2	11	44	126	98	28	1	0	0	0	310	48	43
11:00	0	0	0	0	1	12	73	100	16	7	0	0	0	209	49	45
12 PM	0	0	3	3	3	21	72	75	15	4	1	0	0	197	48	44
13:00	0	0	1	0	7	17	52	58	20	7	0	0	0	162	49	45
14:00	0	0	1	0	9	37	78	61	7	1	0	0	0	194	47	42
15:00	0	0	1	4	8	67	98	51	15	2	0	0	0	246	46	42
16:00	0	3	22	7	36	71	72	25	7	0	0	0	0	243	44	37
17:00	3	0	26	3	27	84	62	23	1	1	0	0	0	230	43	36
18:00	0	1	3	1	9	62	108	49	10	0	0	0	0	243	46	41
19:00	0	3	1	7	9	21	43	38	6	1	0	0	0	129	47	41
20:00	0	0	1	0	1	8	29	23	7	0	0	0	0	69	48	44
21:00	0	0	0	0	3	9	23	12	3	0	0	0	0	50	46	42
22:00	0	0	0	0	0	0	2	15	10	2	0	0	0	29	52	49
23:00	0	0	0	0	0	0	10	8	6	1	0	0	0	25	51	47

%	0.1%	0.2%	1.5%	1.2%	5.9%	21.1%	37.5%	25.2%	6.1%	0.9%	0.0%	0.0%	0.0%			
AM Peak	09:00	09:00	09:00	09:00	08:00	08:00	08:00	06:00	09:00	09:00	09:00			08:00		
Vol.	1	2	2	9	43	145	201	90	31	5	1			504		
Midday Peak			12:00	12:00	14:00	14:00	14:00	11:00	13:00	11:00	12:00			11:00		
Vol.			3	3	9	37	78	100	20	7	1			209		
PM Peak	17:00	16:00	17:00	16:00	16:00	17:00	18:00	15:00	15:00	15:00				15:00		
Vol.	3	3	26	7	36	84	108	51	15	2				246		

% ile
15th Percentile : 35 MPH
50th Percentile : 41 MPH
85th Percentile : 47 MPH
95th Percentile : 50 MPH

Stats
10 MPH Pace Speed : 38-47 MPH
Number in Pace : 2497
Percent in Pace : 61.0%
Number of Vehicles > 40 MPH : 2522
Percent of Vehicles > 40 MPH : 61.6%
Mean Speed(Average) : 42 MPH



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Bypass Road
west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

123082 C Speed
Site Code: TBA

EB

Start Time	14	15	20	25	30	35	40	45	50	55	60	65	70	Total	85th % ile	Ave Speed
11/14/1																
2	0	0	0	0	0	0	1	2	1	0	0	0	0	4	*	47
01:00	0	0	0	0	0	0	0	2	1	0	0	0	0	3	*	49
02:00	0	0	0	0	0	1	0	2	1	0	0	0	0	4	*	46
03:00	0	0	0	0	0	1	4	0	0	1	0	0	0	6	42	44
04:00	0	0	0	0	0	2	3	11	10	0	0	0	0	26	52	48
05:00	0	0	1	0	0	0	26	66	23	6	1	0	0	123	51	47
06:00	0	0	1	0	3	16	111	123	47	7	0	0	0	308	50	45
07:00	0	0	4	2	19	110	209	89	30	3	0	0	0	466	46	42
08:00	0	0	10	17	81	175	208	71	15	1	0	1	0	579	44	39
09:00	0	1	1	6	46	181	181	85	7	0	0	0	0	508	45	40
10:00	0	0	0	0	16	65	109	65	13	0	0	0	0	268	47	42
11:00	0	0	1	1	12	57	103	56	9	1	0	0	0	240	46	42
12 PM	2	3	3	2	11	33	106	64	5	0	0	0	0	229	46	41
13:00	1	1	0	0	5	58	88	58	10	0	1	0	0	222	47	42
14:00	0	1	4	2	13	82	107	40	6	0	0	0	0	255	45	40
15:00	0	0	2	2	10	56	119	57	11	1	0	0	0	258	46	42
16:00	0	1	4	2	19	67	99	72	8	4	0	0	0	276	46	41
17:00	0	0	1	2	16	55	111	80	10	1	0	0	0	276	47	42
18:00	0	0	1	0	5	52	84	57	12	3	2	0	0	216	47	43
19:00	0	0	0	0	2	21	57	38	4	1	0	0	0	123	47	43
20:00	0	0	0	0	0	7	25	33	16	3	0	0	0	84	50	46
21:00	0	0	0	0	1	10	13	21	10	7	0	0	0	62	53	46
22:00	0	0	0	0	1	3	12	19	6	0	0	0	0	41	49	45
23:00	0	0	0	0	0	0	5	5	3	1	1	0	0	15	50	48

%	0.1%	0.2%	0.7%	0.8%	5.7%	22.9%	38.8%	24.3%	5.6%	0.9%	0.1%	0.0%	0.0%
AM Peak Vol.		09:00	08:00	08:00	08:00	09:00	07:00	06:00	06:00	06:00	05:00	08:00	08:00
		1	10	17	81	181	209	123	47	7	1	1	579
Midday Peak Vol.	12:00	12:00	14:00	12:00	14:00	14:00	14:00	12:00	13:00	11:00	13:00		14:00
	2	3	4	2	13	82	107	64	10	1	1		255
PM Peak Vol.		16:00	16:00	15:00	16:00	16:00	15:00	17:00	20:00	21:00	18:00		16:00
		1	4	2	19	67	119	80	16	7	2		276

% ile
15th Percentile : 35 MPH
50th Percentile : 41 MPH
85th Percentile : 47 MPH
95th Percentile : 50 MPH

Stats
10 MPH Pace Speed : 38-47 MPH
Number in Pace : 2868
Percent in Pace : 62.5%
Number of Vehicles > 40 MPH : 2812
Percent of Vehicles > 40 MPH : 61.2%
Mean Speed(Average) : 42 MPH



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west of Lexington Road (Route 2A)
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Client: Toole Design Group/ C. Fink

EB

Start Time	14	15	20	25	30	35	40	45	50	55	60	65	70	Total	85th % ile	Ave Speed
11/15/1																
2	0	0	0	0	0	0	2	5	2	2	0	0	0	11	49	49
01:00	0	0	0	0	0	1	1	2	1	0	0	0	0	5	*	45
02:00	0	0	0	0	0	2	1	1	2	0	0	0	0	6	*	44
03:00	0	0	0	0	0	0	1	4	1	0	0	0	0	6	48	47
04:00	0	0	0	0	0	0	7	11	7	2	0	0	0	27	51	48
05:00	0	1	0	0	0	6	9	59	43	5	1	0	1	125	52	48
06:00	1	2	4	0	2	32	120	95	36	2	0	0	0	294	49	44
07:00	4	3	8	33	68	108	129	59	3	1	0	0	0	416	44	38
08:00	2	6	51	45	119	190	129	45	1	0	0	0	0	588	42	35
09:00	1	2	8	15	54	145	138	25	2	1	0	0	0	391	42	38
10:00	2	2	5	4	20	76	103	33	6	0	0	0	0	251	44	39
11:00	0	1	0	2	26	70	103	51	3	0	0	0	0	256	45	40
12 PM	0	1	1	0	9	78	113	41	3	1	0	0	0	247	45	41
13:00	0	0	1	0	9	51	98	41	6	0	0	0	0	206	45	42
14:00	3	14	32	32	76	57	35	11	0	0	0	0	0	260	40	31
15:00	5	26	49	57	87	38	11	2	0	0	0	0	0	275	34	28
16:00	0	5	6	1	20	67	129	46	11	1	0	0	0	286	45	40
17:00	0	0	1	2	20	77	102	75	15	1	0	0	0	293	47	42
18:00	0	1	1	0	20	91	85	49	6	0	0	0	0	253	45	40
19:00	0	0	0	0	3	18	60	40	6	2	1	0	0	130	47	43
20:00	0	0	0	1	4	11	26	26	9	5	0	0	0	82	50	44
21:00	0	0	0	0	0	3	24	29	4	3	0	0	0	63	49	45
22:00	0	0	0	4	0	6	17	12	7	1	0	0	0	47	49	43
23:00	0	0	0	0	0	1	8	10	2	0	0	0	0	21	48	45

%	0.4%	1.4%	3.7%	4.3%	11.8%	24.9%	32.0%	17.0%	3.9%	0.6%	0.0%	0.0%	0.0%			
AM Peak Vol.	07:00	08:00	08:00	08:00	08:00	08:00	09:00	06:00	05:00	05:00	05:00		05:00	08:00		
	4	6	51	45	119	190	138	95	43	5	1		1	588		
Midday Peak Vol.	14:00	14:00	14:00	14:00	14:00	12:00	12:00	11:00	13:00	12:00				14:00		
	3	14	32	32	76	78	113	51	6	1				260		
PM Peak Vol.	15:00	15:00	15:00	15:00	15:00	18:00	16:00	17:00	17:00	20:00	19:00			17:00		
	5	26	49	57	87	91	129	75	15	5	1			293		
% ile			15th Percentile :			30 MPH										
			50th Percentile :			39 MPH										
			85th Percentile :			45 MPH										
			95th Percentile :			49 MPH										

Stats

10 MPH Pace Speed : 36-45 MPH

Number in Pace : 2433

Percent in Pace : 53.6%

Number of Vehicles > 40 MPH : 2104

Percent of Vehicles > 40 MPH : 46.4%

Mean Speed(Average) : 39 MPH



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Site Code: TBA

EB

Start Time	14	15	20	25	30	35	40	45	50	55	60	65	70	Total	85th % ile	Ave Speed
11/16/1																
2	0	0	0	0	0	1	3	8	2	0	0	0	0	14	49	46
01:00	0	0	0	0	0	1	0	2	0	0	0	0	0	3	*	44
02:00	0	0	0	0	0	1	0	0	3	0	0	0	0	4	51	48
03:00	0	0	0	0	0	0	3	3	2	0	0	0	0	8	47	46
04:00	0	0	0	0	1	1	8	10	5	2	1	0	0	28	52	47
05:00	0	0	1	0	0	0	16	57	35	9	0	2	0	120	52	49
06:00	0	0	0	0	7	45	105	111	19	3	0	0	0	290	48	44
07:00	0	0	2	0	16	128	181	107	12	1	0	0	0	447	46	42
08:00	0	0	2	3	36	151	219	84	17	1	0	0	0	513	45	41
09:00	2	0	2	9	38	119	118	51	11	1	0	0	0	351	45	39
10:00	0	0	1	6	33	88	110	49	4	1	0	0	0	292	45	40
11:00	1	1	0	1	10	61	92	53	11	1	0	0	0	231	46	41
12 PM	1	0	2	4	23	67	117	43	7	1	0	0	0	265	45	40
13:00	0	1	1	1	20	46	84	50	8	2	0	0	0	213	46	41
14:00	0	0	1	1	5	73	102	58	2	0	0	0	0	242	46	41
15:00	1	1	2	6	22	74	108	79	7	0	0	0	0	300	46	41
16:00	0	1	0	4	22	88	106	38	8	3	0	0	0	270	45	40
17:00	0	0	0	3	24	84	102	52	16	1	1	0	0	283	46	41
18:00	0	3	9	4	5	48	118	57	16	1	0	0	0	261	47	41
19:00	0	0	0	0	0	7	49	45	18	1	1	0	0	121	49	45
20:00	0	0	0	0	0	4	27	16	11	1	0	0	0	59	50	45
21:00	0	0	0	1	1	5	18	18	11	2	0	0	0	56	50	45
22:00	0	0	0	1	1	3	16	18	4	2	0	0	0	45	49	45
23:00	0	0	0	0	0	6	12	12	4	2	1	0	0	37	50	45

%	0.1%	0.2%	0.5%	1.0%	5.9%	24.7%	38.5%	22.9%	5.2%	0.8%	0.1%	0.0%	0.0%
AM Peak Vol.	09:00		07:00	09:00	09:00	08:00	08:00	06:00	05:00	05:00	04:00	05:00	08:00
	2		2	9	38	151	219	111	35	9	1	2	513
Midday Peak Vol.	11:00	11:00	12:00	12:00	12:00	14:00	12:00	14:00	11:00	13:00			12:00
	1	1	2	4	23	73	117	58	11	2			265
PM Peak Vol.	15:00	18:00	18:00	15:00	17:00	16:00	18:00	15:00	19:00	16:00	17:00		15:00
	1	3	9	6	24	88	118	79	18	3	1		300

% ile
15th Percentile : 35 MPH
50th Percentile : 41 MPH
85th Percentile : 47 MPH
95th Percentile : 50 MPH

Stats
10 MPH Pace Speed : 37-46 MPH
Number in Pace : 2779
Percent in Pace : 62.4%
Number of Vehicles > 40 MPH : 2637
Percent of Vehicles > 40 MPH : 59.2%
Mean Speed(Average) : 42 MPH



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123082 C Speed
Site Code: TBA

EB

Start Time	14	15	20	25	30	35	40	45	50	55	60	65	70	Total	85th % ile	Ave Speed
11/17/1																
2	0	0	0	0	0	3	7	3	1	0	0	0	0	14	46	43
01:00	0	0	0	0	0	2	2	5	1	0	0	0	0	10	48	45
02:00	0	0	0	0	0	0	3	1	1	2	0	0	0	7	42	48
03:00	0	0	0	0	0	1	1	4	1	0	0	0	0	7	48	46
04:00	0	0	0	0	0	0	0	3	2	1	0	0	0	6	48	50
05:00	0	0	1	0	0	1	3	10	9	2	1	0	0	27	52	48
06:00	0	0	1	3	0	5	16	23	24	2	0	0	0	74	51	46
07:00	0	0	0	1	1	9	44	60	18	2	0	0	0	135	49	45
08:00	0	0	0	0	1	10	78	81	15	3	0	0	0	188	48	45
09:00	0	1	0	0	1	37	93	65	15	1	0	0	0	213	47	43
10:00	0	1	0	4	4	22	106	83	17	0	1	0	0	238	48	43
11:00	0	0	0	2	0	34	117	95	18	1	0	0	0	267	48	44
12 PM	0	1	1	5	4	38	142	67	11	3	1	0	0	273	47	43
13:00	0	0	0	1	5	29	115	70	15	3	0	0	0	238	47	43
14:00	0	0	1	1	4	57	127	82	7	0	1	0	0	280	46	43
15:00	0	0	0	2	1	35	118	79	16	1	0	0	0	252	47	43
16:00	0	1	0	0	0	28	100	56	23	2	0	0	0	210	48	44
17:00	0	0	1	6	2	30	80	58	10	2	0	0	0	189	47	43
18:00	0	0	1	0	2	23	72	35	18	1	0	0	0	152	48	43
19:00	0	0	1	1	0	9	35	29	12	6	0	0	0	93	50	45
20:00	0	1	1	1	2	4	24	29	6	3	0	0	0	71	49	44
21:00	0	0	0	0	1	8	14	19	6	0	0	0	0	48	48	44
22:00	0	0	0	0	0	7	19	17	6	2	0	0	0	51	49	45
23:00	0	0	0	0	0	4	13	13	9	2	0	0	0	41	51	46

%	0.0%	0.2%	0.3%	0.9%	0.9%	12.8%	43.1%	32.0%	8.5%	1.3%	0.1%	0.0%	0.0%			
AM Peak Vol.	09:00	05:00	06:00	07:00	09:00	09:00	08:00	06:00	08:00	05:00				09:00		
	1	1	3	1	37	93	81	24	3	1				213		
Midday Peak Vol.	12:00	12:00	12:00	13:00	14:00	12:00	11:00	11:00	12:00	12:00				14:00		
	1	1	5	5	57	142	95	18	3	1				280		
PM Peak Vol.	16:00	17:00	17:00	17:00	15:00	15:00	15:00	16:00	19:00					15:00		
	1	1	6	2	35	118	79	23	6					252		
% ile		15th Percentile :				38 MPH										
		50th Percentile :				43 MPH										
		85th Percentile :				48 MPH										
		95th Percentile :				51 MPH										

Stats 10 MPH Pace Speed : 39-48 MPH
 Number in Pace : 2130
 Percent in Pace : 69.1%
 Number of Vehicles > 40 MPH : 2315
 Percent of Vehicles > 40 MPH : 75.1%
 Mean Speed(Average) : 44 MPH



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Client: Toole Design Group/ C. Fink

EB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/18/1																
2	0	0	0	0	1	5	3	7	2	1	0	0	0	19	48	44
01:00	0	0	0	0	1	1	3	3	2	1	0	0	0	11	47	45
02:00	0	0	0	0	0	2	1	3	0	0	0	0	0	6	46	43
03:00	0	0	0	0	0	0	1	2	1	0	0	0	0	4	*	47
04:00	0	0	0	0	0	0	2	1	3	0	0	0	0	6	51	48
05:00	0	0	0	0	0	2	7	4	2	1	0	0	0	16	48	45
06:00	0	0	0	0	1	0	12	18	5	2	0	0	0	38	50	46
07:00	0	0	1	0	1	6	11	23	12	6	0	0	0	60	52	46
08:00	0	0	1	0	0	8	45	63	17	4	0	1	0	139	49	46
09:00	0	0	0	0	0	6	49	90	23	2	1	0	0	171	49	46
10:00	0	0	0	0	0	11	74	91	26	4	1	0	0	207	49	46
11:00	0	0	4	1	2	11	80	73	25	4	0	0	0	200	49	45
12 PM	0	0	0	1	1	17	78	103	33	2	1	0	0	236	49	45
13:00	0	0	0	1	1	16	80	99	20	2	1	0	0	220	48	45
14:00	0	0	0	0	0	24	101	70	29	3	0	0	0	227	49	44
15:00	0	0	0	1	5	31	87	79	15	4	0	0	0	222	48	44
16:00	0	0	1	0	4	13	89	60	9	7	0	1	0	184	48	44
17:00	0	0	1	1	3	27	54	36	11	0	1	0	0	134	47	43
18:00	0	0	0	0	2	5	40	31	12	2	0	0	0	92	49	45
19:00	0	0	0	0	0	6	16	20	10	2	0	0	0	54	50	46
20:00	0	0	0	0	0	4	21	24	8	2	0	0	0	59	49	46
21:00	0	0	0	0	0	1	8	25	1	1	1	0	0	37	48	46
22:00	0	0	0	0	2	1	12	9	9	1	0	0	0	34	51	46
23:00	0	0	0	0	0	0	3	6	4	0	0	0	0	13	51	47

%	0.0%	0.0%	0.3%	0.2%	1.0%	8.2%	36.7%	39.3%	11.7%	2.1%	0.3%	0.1%	0.0%															
AM Peak Vol.			07:00		00:00	08:00	09:00	09:00	09:00	07:00	09:00	08:00		09:00														
			1		1	8	49	90	23	6	1	1		171														
Midday Peak Vol.			11:00	11:00	11:00	14:00	14:00	12:00	12:00	11:00	12:00			12:00														
			4	1	2	24	101	103	33	4	1			236														
PM Peak Vol.			16:00	15:00	15:00	15:00	16:00	15:00	15:00	16:00	17:00	16:00		15:00														
			1	1	5	31	89	79	15	7	1	1		222														
% ile			15th Percentile :			39 MPH																						
			50th Percentile :			44 MPH																						
			85th Percentile :			49 MPH																						
			95th Percentile :			53 MPH																						

Stats

10 MPH Pace Speed : 40-49 MPH

Number in Pace : 1657

Percent in Pace : 69.4%

Number of Vehicles > 40 MPH : 1952

Percent of Vehicles > 40 MPH : 81.7%

Mean Speed(Average) : 45 MPH



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

Bypass Road
west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

123082 C Speed
Site Code: TBA

EB

Start Time	14	15	20	25	30	35	40	45	50	55	60	65	70	Total	85th % ile	Ave Speed
11/19/1																
2	0	0	0	0	0	0	1	4	1	0	0	0	0	6	48	47
01:00	0	0	0	0	0	1	0	2	0	2	0	0	0	5	*	49
02:00	0	0	0	0	0	0	0	0	1	0	0	0	0	1	*	52
03:00	0	0	0	0	0	0	1	3	2	0	0	0	0	6	48	48
04:00	0	0	0	0	0	1	6	11	2	1	0	0	0	21	48	46
05:00	0	0	1	0	0	2	17	64	28	4	0	0	0	116	51	47
06:00	0	0	0	0	4	35	114	106	33	1	0	0	0	293	48	44
07:00	0	0	1	4	22	109	193	94	18	1	0	0	0	442	46	42
08:00	0	0	2	4	45	202	233	96	13	1	0	0	0	596	45	40
09:00	0	1	0	0	21	88	169	101	20	1	0	0	0	401	47	42
10:00	0	0	1	1	1	33	106	88	19	0	0	0	0	249	48	44
11:00	0	0	1	0	2	40	82	67	16	1	0	0	0	209	48	43
12 PM	0	0	1	1	16	33	80	84	12	2	0	0	0	229	47	43
13:00	1	0	1	1	5	32	78	58	9	1	0	0	0	186	47	42
14:00	0	1	1	7	8	33	86	79	17	1	0	0	0	233	48	43
15:00	0	3	5	5	19	63	117	57	10	0	0	0	0	279	46	41
16:00	0	0	2	0	13	58	106	57	17	0	0	0	0	253	47	42
17:00	0	1	1	1	9	69	106	72	14	0	0	0	0	273	47	42
18:00	0	0	0	4	7	48	79	55	9	2	0	1	0	205	47	42
19:00	0	0	0	1	8	8	38	50	13	2	1	0	0	121	49	44
20:00	0	0	0	0	2	9	21	24	8	1	0	0	0	65	49	44
21:00	0	0	0	0	1	0	20	23	10	0	0	0	0	54	50	46
22:00	0	0	0	0	0	5	11	13	8	0	0	0	0	37	50	45
23:00	0	0	1	0	1	1	12	7	9	0	0	0	0	31	51	45

%	0.0%	0.1%	0.4%	0.7%	4.3%	20.2%	38.9%	28.2%	6.7%	0.5%	0.0%	0.0%	0.0%			
AM Peak Vol.		09:00	08:00	07:00	08:00	08:00	08:00	06:00	06:00	05:00				08:00		
		1	2	4	45	202	233	106	33	4				596		
Midday Peak Vol.	13:00	14:00	11:00	14:00	12:00	11:00	14:00	12:00	14:00	12:00				14:00		
	1	1	1	7	16	40	86	84	17	2				233		
PM Peak Vol.		15:00	15:00	15:00	15:00	17:00	15:00	17:00	16:00	18:00	19:00	18:00		15:00		
		3	5	5	19	69	117	72	17	2	1	1		279		

% ile	15th Percentile :	36 MPH
	50th Percentile :	42 MPH
	85th Percentile :	47 MPH
	95th Percentile :	50 MPH

Stats	10 MPH Pace Speed :	38-47 MPH
	Number in Pace :	2751
	Percent in Pace :	63.8%
	Number of Vehicles > 40 MPH :	2833
	Percent of Vehicles > 40 MPH :	65.7%
	Mean Speed(Average) :	42 MPH



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

123082 C Volume
Site Code: TBA

Bypass Road
west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

Start Time	13-Nov-12		14-Nov-12		15-Nov-12		16-Nov-12		17-Nov-12		18-Nov-12		19-Nov-12		Week Average	
	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB
12:00 AM	20	9	9	4	9	11	21	14	27	14	33	19	12	6	19	11
01:00	7	2	8	3	9	5	8	3	13	10	19	11	9	5	10	6
02:00	2	0	6	4	5	6	5	4	6	7	8	6	4	1	5	4
03:00	2	7	7	6	13	6	9	8	7	7	4	4	7	6	7	6
04:00	6	22	10	26	12	27	9	28	17	6	3	6	7	21	9	19
05:00	54	132	57	123	56	125	50	120	15	27	9	16	45	116	41	94
06:00	163	298	161	308	160	294	160	290	66	74	40	38	166	293	131	228
07:00	277	441	290	466	308	416	283	447	83	135	51	60	289	442	226	344
08:00	288	504	306	579	284	588	285	513	143	188	83	139	294	596	240	444
09:00	249	345	235	508	256	391	216	351	203	213	128	171	230	401	217	340
10:00	197	310	208	268	196	251	225	292	219	238	169	207	184	249	200	259
11:00	201	209	223	240	241	256	262	231	251	267	194	200	204	209	225	230
12:00 PM	222	197	271	229	286	247	271	265	282	273	243	236	229	229	258	239
01:00	252	162	281	222	290	206	294	213	273	238	257	220	246	186	270	207
02:00	365	194	336	255	356	260	399	242	318	280	259	227	351	233	341	242
03:00	494	246	434	258	446	275	501	300	301	252	259	222	447	279	412	262
04:00	523	243	534	276	530	286	491	270	317	210	278	184	527	253	457	246
05:00	485	230	511	276	567	293	536	283	235	189	149	134	571	273	436	240
06:00	551	243	538	216	471	253	387	261	168	152	164	92	432	205	387	203
07:00	252	129	322	123	230	130	192	121	124	93	121	54	293	121	219	110
08:00	160	69	173	84	193	82	138	59	122	71	87	59	147	65	146	70
09:00	114	50	155	62	133	63	117	56	109	48	55	37	118	54	114	53
10:00	59	29	91	41	61	47	119	45	106	51	35	34	59	37	76	41
11:00	43	25	36	15	43	21	71	37	69	41	31	13	44	31	48	26
Total	4986	4096	5202	4592	5155	4539	5049	4453	3474	3084	2679	2389	4915	4311	4494	3924
Day	9082		9794		9694		9502		6558		5068		9226		8418	
AM Peak	08:00	08:00	08:00	08:00	07:00	08:00	08:00	08:00	11:00	11:00	11:00	10:00	08:00	08:00	08:00	08:00
Vol.	288	504	306	579	308	588	285	513	251	267	194	207	294	596	240	444
PM Peak	18:00	15:00	18:00	16:00	17:00	17:00	17:00	15:00	14:00	14:00	16:00	12:00	17:00	15:00	16:00	15:00
Vol.	551	246	538	276	567	293	536	300	318	280	278	236	571	279	457	262

Comb. Total	9082	9794	9694	9502	6558	5068	9226	8418
ADT	ADT 8,418	AADT 8,418						

Bypass Road
west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink



123082 C Volume
Site Code: TBA

Start	WB		EB		Combined		13-Nov-12
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	Tue
12:00	4	53	3	48	7	101	
12:15	12	57	2	48	14	105	
12:30	1	47	3	58	4	105	
12:45	3	65	1	43	4	108	419
01:00	3	54	0	33	3	87	
01:15	0	67	1	45	1	112	
01:30	2	60	0	44	2	104	
01:45	2	71	1	40	3	111	414
02:00	1	80	0	44	1	124	
02:15	0	71	0	69	0	140	
02:30	0	120	0	36	0	156	
02:45	1	94	0	45	1	139	559
03:00	0	107	1	55	1	162	
03:15	1	117	2	72	3	189	
03:30	1	129	2	50	3	179	
03:45	0	141	2	69	2	210	740
04:00	2	134	4	55	6	189	
04:15	2	150	5	71	7	221	
04:30	1	132	3	60	4	192	
04:45	1	107	10	57	11	164	766
05:00	11	97	16	38	27	135	
05:15	10	112	16	64	26	176	
05:30	13	131	43	61	56	192	
05:45	20	145	57	67	77	212	715
06:00	27	152	70	65	97	217	
06:15	40	158	56	55	96	213	
06:30	37	109	94	57	131	166	
06:45	59	132	78	66	137	198	794
07:00	66	109	101	45	167	154	
07:15	71	53	114	26	185	79	
07:30	62	48	116	35	178	83	
07:45	78	42	110	23	188	65	381
08:00	73	46	125	20	198	66	
08:15	62	41	130	19	192	60	
08:30	64	35	144	15	208	50	
08:45	89	38	105	15	194	53	229
09:00	68	37	130	18	198	55	
09:15	69	36	88	18	157	54	
09:30	54	20	59	6	113	26	
09:45	58	21	68	8	126	29	164
10:00	64	17	90	5	154	22	
10:15	45	17	88	11	133	28	
10:30	39	12	58	4	97	16	
10:45	49	13	74	9	123	22	88
11:00	52	17	45	10	97	27	
11:15	54	7	62	5	116	12	
11:30	40	11	54	6	94	17	
11:45	55	8	48	4	103	12	68
Total	1466	3520	2279	1817	3745	5337	
Percent	39.1%	66.0%	60.9%	34.0%			
Day Total	4986		4096		9082		
Peak	08:30	05:30	07:45	05:15	08:00	05:30	
Vol.	290	586	509	257	792	834	
P.H.F.	0.815	0.927	0.884	0.905	0.952	0.943	

Bypass Road
west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink



123082 C Volume
Site Code: TBA

Start	WB		EB		Combined		14-Nov-12 Wed
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
12:00	3	47	1	61	4	108	
12:15	2	86	1	59	3	145	
12:30	2	77	2	48	4	125	
12:45	2	61	0	61	2	122	500
01:00	4	80	1	53	5	133	
01:15	0	62	0	57	0	119	
01:30	3	71	1	56	4	127	
01:45	1	68	1	56	2	124	503
02:00	2	68	1	52	3	120	
02:15	1	80	2	61	3	141	
02:30	1	113	0	63	1	176	
02:45	2	75	1	79	3	154	591
03:00	2	96	2	62	4	158	
03:15	0	106	1	64	1	170	
03:30	3	123	1	79	4	202	
03:45	2	109	2	53	4	162	692
04:00	0	112	6	76	6	188	
04:15	4	130	1	72	5	202	
04:30	2	138	5	79	7	217	
04:45	4	154	14	49	18	203	810
05:00	9	140	10	69	19	209	
05:15	10	116	22	70	32	186	
05:30	14	143	37	71	51	214	
05:45	24	112	54	66	78	178	787
06:00	28	138	64	60	92	198	
06:15	43	129	79	60	122	189	
06:30	36	130	68	50	104	180	
06:45	54	141	97	46	151	187	754
07:00	67	129	100	41	167	170	
07:15	71	94	116	31	187	125	
07:30	60	39	125	27	185	66	
07:45	92	60	125	24	217	84	445
08:00	68	47	132	13	200	60	
08:15	69	54	148	29	217	83	
08:30	88	35	153	33	241	68	
08:45	81	37	146	9	227	46	257
09:00	66	45	126	17	192	62	
09:15	64	47	147	12	211	59	
09:30	58	34	126	16	184	50	
09:45	47	29	109	17	156	46	217
10:00	33	24	63	13	96	37	
10:15	47	30	67	15	114	45	
10:30	64	18	80	7	144	25	
10:45	64	19	58	6	122	25	132
11:00	58	10	63	7	121	17	
11:15	52	8	58	3	110	11	
11:30	55	9	60	4	115	13	
11:45	58	9	59	1	117	10	51
Total	1520	3682	2535	2057	4055	5739	
Percent	37.5%	64.2%	62.5%	35.8%			
Day Total	5202		4592		9794		
Peak	07:45	04:15	08:00	02:45	08:00	04:15	
Vol.	317	562	579	284	885	831	
P.H.F.	0.861	0.912	0.946	0.899	0.918	0.957	



PRECISION
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Bypass Road
west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

123082 C Volume
Site Code: TBA

Start	WB		EB		Combined		15-Nov-12
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	Thu
12:00	1	66	3	59	4	125	
12:15	2	63	5	52	7	115	
12:30	2	75	0	69	2	144	
12:45	4	82	3	67	7	149	533
01:00	2	69	1	52	3	121	
01:15	3	64	1	45	4	109	
01:30	1	70	2	52	3	122	
01:45	3	87	1	57	4	144	496
02:00	3	81	4	68	7	149	
02:15	1	84	0	62	1	146	
02:30	1	99	1	60	2	159	
02:45	0	92	1	70	1	162	616
03:00	4	104	2	56	6	160	
03:15	2	95	1	78	3	173	
03:30	2	116	0	82	2	198	
03:45	5	131	3	59	8	190	721
04:00	4	120	2	66	6	186	
04:15	2	147	5	71	7	218	
04:30	1	127	9	81	10	208	
04:45	5	136	11	68	16	204	816
05:00	7	152	12	69	19	221	
05:15	13	137	25	75	38	212	
05:30	10	151	34	75	44	226	
05:45	26	127	54	74	80	201	860
06:00	22	133	53	70	75	203	
06:15	42	138	79	62	121	200	
06:30	44	109	75	60	119	169	
06:45	52	91	87	61	139	152	724
07:00	66	83	93	38	159	121	
07:15	63	54	106	33	169	87	
07:30	74	49	120	34	194	83	
07:45	105	44	97	25	202	69	360
08:00	65	50	151	22	216	72	
08:15	64	44	168	27	232	71	
08:30	82	54	127	20	209	74	
08:45	73	45	142	13	215	58	275
09:00	61	34	124	22	185	56	
09:15	65	34	88	16	153	50	
09:30	81	41	69	11	150	52	
09:45	49	24	110	14	159	38	196
10:00	50	19	51	8	101	27	
10:15	48	12	73	12	121	24	
10:30	41	16	61	11	102	27	
10:45	57	14	66	16	123	30	108
11:00	52	17	64	4	116	21	
11:15	55	10	69	11	124	21	
11:30	62	7	57	5	119	12	
11:45	72	9	66	1	138	10	64
Total	1549	3606	2376	2163	3925	5769	
Percent	39.5%	62.5%	60.5%	37.5%			
Day Total		5155		4539		9694	
Peak	07:45	04:45	08:00	05:15	08:00	04:45	
Vol.	316	576	588	294	872	863	
P.H.F.	0.752	0.947	0.875	0.980	0.940	0.955	

Bypass Road
west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink



123082 C Volume
Site Code: TBA

Start	WB		EB		Combined		16-Nov-12 Fri
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
12:00	11	59	4	66	15	125	
12:15	7	54	2	62	9	116	
12:30	2	86	4	62	6	148	
12:45	1	72	4	75	5	147	536
01:00	2	75	1	59	3	134	
01:15	1	70	0	45	1	115	
01:30	2	71	2	64	4	135	
01:45	3	78	0	45	3	123	507
02:00	1	85	1	64	2	149	
02:15	3	86	1	57	4	143	
02:30	0	123	1	58	1	181	
02:45	1	105	1	63	2	168	641
03:00	2	136	2	68	4	204	
03:15	4	131	2	63	6	194	
03:30	1	117	2	84	3	201	
03:45	2	117	2	85	4	202	801
04:00	3	112	6	79	9	191	
04:15	2	120	3	64	5	184	
04:30	1	131	6	55	7	186	
04:45	3	128	13	72	16	200	761
05:00	9	123	15	69	24	192	
05:15	9	146	19	74	28	220	
05:30	12	147	32	69	44	216	
05:45	20	120	54	71	74	191	819
06:00	29	133	42	72	71	205	
06:15	35	98	73	74	108	172	
06:30	45	97	85	61	130	158	
06:45	51	59	90	54	141	113	648
07:00	59	56	106	36	165	92	
07:15	70	45	101	26	171	71	
07:30	75	47	119	35	194	82	
07:45	79	44	121	24	200	68	313
08:00	65	41	141	16	206	57	
08:15	77	35	119	12	196	47	
08:30	74	30	145	13	219	43	
08:45	69	32	108	18	177	50	197
09:00	51	26	94	15	145	41	
09:15	46	30	98	10	144	40	
09:30	61	32	67	12	128	44	
09:45	58	29	92	19	150	48	173
10:00	38	40	71	14	109	54	
10:15	58	33	81	13	139	46	
10:30	57	23	66	8	123	31	
10:45	72	23	74	10	146	33	164
11:00	71	23	64	12	135	35	
11:15	65	28	56	11	121	39	
11:30	62	12	60	7	122	19	
11:45	64	8	51	7	115	15	108
Total	1533	3516	2301	2152	3834	5668	
Percent	40.0%	62.0%	60.0%	38.0%			
Day Total	5049		4453		9502		
Peak	07:30	05:15	07:45	03:30	07:45	05:15	
Vol.	296	546	526	312	821	832	
P.H.F.	0.937	0.929	0.907	0.918	0.937	0.945	



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

Bypass Road
west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink

123082 C Volume
Site Code: TBA

Start	WB		EB		Combined		17-Nov-12 Sat
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
12:00	7	65	4	66	11	131	
12:15	4	76	7	58	11	134	
12:30	8	63	1	66	9	129	
12:45	8	27 78	2 282	14 83	10 273	41 161	555
01:00	7	57	2	53	9	110	
01:15	2	65	3	66	5	131	
01:30	2	77	3	60	5	137	
01:45	2	13 74	2 273	10 59	4 238	23 133	511
02:00	3	79	3	72	6	151	
02:15	1	86	2	65	3	151	
02:30	1	71	0	66	1	137	
02:45	1	6 82	2 318	7 77	3 280	13 159	598
03:00	2	73	1	64	3	137	
03:15	2	75	4	69	6	144	
03:30	1	75	2	63	3	138	
03:45	2	7 78	0 301	7 56	2 252	14 134	553
04:00	3	66	3	53	6	119	
04:15	4	83	1	50	5	133	
04:30	3	97	0	54	3	151	
04:45	7	17 71	2 317	6 53	9 210	23 124	527
05:00	2	84	3	51	5	135	
05:15	5	54	5	39	10	93	
05:30	3	47	10	55	13	102	
05:45	5	15 50	9 235	27 44	14 189	42 94	424
06:00	12	61	10	42	22	103	
06:15	21	40	17	35	38	75	
06:30	14	43	21	46	35	89	
06:45	19	66 24	168 26	74 29	152 45	140 53	320
07:00	14	31	24	38	38	69	
07:15	17	43	34	24	51	67	
07:30	26	23	38	21	64	44	
07:45	26	83 27	124 39	135 10	93 65	218 37	217
08:00	32	31	39	19	71	50	
08:15	29	36	34	15	63	51	
08:30	38	27	46	16	84	43	
08:45	44	143 28	122 69	188 21	71 113	331 49	193
09:00	48	27	41	12	89	39	
09:15	31	30	63	10	94	40	
09:30	65	25	56	12	121	37	
09:45	59	203 27	109 53	213 14	48 112	416 41	157
10:00	75	21	70	12	145	33	
10:15	36	28	55	11	91	39	
10:30	61	31	58	14	119	45	
10:45	47	219 26	106 55	238 14	51 102	457 40	157
11:00	46	20	65	12	111	32	
11:15	46	16	67	4	113	20	
11:30	82	20	69	7	151	27	
11:45	77	251 13	69 66	267 18	41 143	518 31	110
Total	1050	2424	1186	1898	2236	4322	
Percent	47.0%	56.1%	53.0%	43.9%			
Day Total		3474		3084		6558	
Peak	11:00	04:15	11:00	02:00	11:00	02:00	
Vol.	251	335	267	280	518	598	
P.H.F.	0.765	0.863	0.967	0.843	0.858	0.940	

Bypass Road
west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink



123082 C Volume
Site Code: TBA

Start	WB		EB		Combined		18-Nov-12
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	Sun
12:00	6	46	5	63	11	109	
12:15	8	57	6	52	14	109	
12:30	12	70	4	61	16	131	
12:45	7	70	4	60	11	130	479
01:00	8	74	5	68	13	142	
01:15	9	61	6	47	15	108	
01:30	2	71	0	60	2	131	
01:45	0	51	0	45	0	96	477
02:00	3	62	3	63	6	125	
02:15	3	68	1	52	4	120	
02:30	2	69	1	57	3	126	
02:45	0	60	1	55	1	115	486
03:00	0	63	1	55	1	118	
03:15	1	63	0	49	1	112	
03:30	2	70	3	54	5	124	
03:45	1	63	0	64	1	127	481
04:00	2	91	1	53	3	144	
04:15	0	57	2	37	2	94	
04:30	1	60	3	49	4	109	
04:45	0	70	0	45	0	115	462
05:00	1	49	3	25	4	74	
05:15	4	43	1	47	5	90	
05:30	2	23	7	30	9	53	
05:45	2	34	5	32	7	66	283
06:00	7	39	1	26	8	65	
06:15	9	48	6	25	15	73	
06:30	14	47	15	25	29	72	
06:45	10	30	16	16	26	46	256
07:00	10	28	16	10	26	38	
07:15	11	41	14	9	25	50	
07:30	14	27	15	12	29	39	
07:45	16	25	15	23	31	48	175
08:00	19	23	15	15	34	38	
08:15	15	22	18	14	33	36	
08:30	24	11	59	15	83	26	
08:45	25	31	47	15	72	46	146
09:00	27	10	55	12	82	22	
09:15	33	11	44	8	77	19	
09:30	44	14	37	8	81	22	
09:45	24	20	35	9	59	29	92
10:00	38	15	43	10	81	25	
10:15	41	8	44	9	85	17	
10:30	43	4	55	11	98	15	
10:45	47	8	65	4	112	12	69
11:00	50	11	54	5	104	16	
11:15	42	11	50	3	92	14	
11:30	48	3	48	2	96	5	
11:45	54	6	48	3	102	9	44
Total	741	1938	877	1512	1618	3450	
Percent	45.8%	56.2%	54.2%	43.8%			
Day Total	2679		2389		5068		
Peak	11:00	03:15	10:30	00:15	10:30	00:15	
Vol.	194	287	224	241	406	512	
P.H.F.	0.898	0.788	0.862	0.886	0.906	0.901	

Bypass Road
west of Lexington Road (Route 2A)
City, State: Lincoln, MA
Client: Toole Design Group/ C. Fink



123082 C Volume
Site Code: TBA

Start	WB		EB		Combined		19-Nov-12
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	Mon
12:00	9	51	3	45	12	96	
12:15	1	57	2	48	3	105	
12:30	1	54	0	67	1	121	
12:45	1	67	1	69	2	136	458
01:00	3	52	2	44	5	96	
01:15	2	65	1	45	3	110	
01:30	1	59	1	44	2	103	
01:45	3	70	1	53	4	123	432
02:00	1	68	0	57	1	125	
02:15	1	85	1	62	2	147	
02:30	2	102	0	46	2	148	
02:45	0	96	0	68	0	164	584
03:00	3	98	1	66	4	164	
03:15	0	110	3	85	3	195	
03:30	3	122	1	48	4	170	
03:45	1	117	1	80	2	197	726
04:00	2	131	2	53	4	184	
04:15	1	114	3	68	4	182	
04:30	0	122	3	71	3	193	
04:45	4	160	13	61	17	221	780
05:00	2	128	13	69	15	197	
05:15	6	162	22	70	28	232	
05:30	18	133	28	77	46	210	
05:45	19	148	53	57	72	205	844
06:00	34	134	56	53	90	187	
06:15	29	109	71	63	100	172	
06:30	49	93	70	38	119	131	
06:45	54	96	96	51	150	147	637
07:00	66	112	76	43	142	155	
07:15	67	93	117	37	184	130	
07:30	78	42	118	26	196	68	
07:45	78	46	131	15	209	61	414
08:00	70	36	152	17	222	53	
08:15	86	33	140	22	226	55	
08:30	69	43	167	14	236	57	
08:45	69	35	137	12	206	47	212
09:00	62	43	127	24	189	67	
09:15	64	33	113	10	177	43	
09:30	54	21	90	10	144	31	
09:45	50	21	71	10	121	31	172
10:00	39	21	71	12	110	33	
10:15	39	18	72	8	111	26	
10:30	58	9	46	9	104	18	
10:45	48	11	60	8	108	19	96
11:00	39	18	52	11	91	29	
11:15	57	10	36	7	93	17	
11:30	58	10	62	5	120	15	
11:45	50	6	59	8	109	14	75
Total	1451	3464	2345	1966	3796	5430	
Percent	38.2%	63.8%	61.8%	36.2%			
Day Total		4915		4311		9226	
Peak	07:30	04:45	08:00	03:00	07:45	04:45	
Vol.	312	583	596	279	893	860	
P.H.F.	0.907	0.900	0.892	0.821	0.946	0.927	



PRECISION
D A T A
INDUSTRIES, LLC

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Old Bedford Road
south of Bedford Street (Route 62)
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 D Class
Site Code: TBA

SB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/13/1														
2	0	2	0	0	0	0	0	0	0	0	0	0	0	2
01:00	0	1	1	0	0	0	0	0	0	0	0	0	0	2
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
04:00	0	4	0	0	0	0	0	0	0	0	0	0	0	4
05:00	0	15	8	0	3	0	0	0	0	0	0	0	0	26
06:00	0	98	26	0	6	0	0	2	0	0	0	0	0	132
07:00	1	306	46	6	8	0	0	0	0	0	0	0	0	367
08:00	0	274	37	0	6	0	0	0	0	0	0	0	0	317
09:00	0	168	37	2	7	0	0	1	0	0	0	0	0	215
10:00	0	60	20	0	8	2	0	1	0	0	0	0	0	91
11:00	0	54	13	0	5	0	0	1	0	0	0	0	0	73
12 PM	1	76	22	0	3	0	0	0	0	0	0	0	0	102
13:00	0	74	11	2	3	0	0	0	0	0	0	0	0	90
14:00	0	76	24	3	8	0	0	1	0	0	0	0	0	112
15:00	1	99	31	1	5	0	0	0	0	0	0	0	0	137
16:00	1	117	22	0	2	1	0	0	0	0	0	0	0	143
17:00	1	120	21	0	1	0	0	0	0	0	0	0	0	143
18:00	0	88	20	0	1	0	0	0	0	0	0	0	0	109
19:00	0	57	8	0	0	0	0	0	0	0	0	0	0	65
20:00	0	28	3	0	1	0	0	0	0	0	0	0	0	32
21:00	0	24	1	0	2	0	0	0	0	0	0	0	0	27
22:00	0	10	2	0	0	0	0	0	0	0	0	0	0	12
23:00	0	6	1	0	0	0	0	0	0	0	0	0	0	7
Total	5	1758	354	14	69	3	0	6	0	0	0	0	0	2209
Percent	0.2%	79.6%	16.0%	0.6%	3.1%	0.1%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	07:00	07:00	07:00	07:00	07:00	10:00		06:00						07:00
Vol.	1	306	46	6	8	2		2						367
PM Peak	12:00	17:00	15:00	14:00	14:00	16:00		14:00						16:00
Vol.	1	120	31	3	8	1		1						143



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Old Bedford Road
south of Bedford Street (Route 62)
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 D Class
Site Code: TBA

SB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/14/1														
2	0	3	0	0	1	0	0	0	0	0	0	0	0	4
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
03:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
04:00	0	5	1	0	0	0	0	0	0	0	0	0	0	6
05:00	0	16	6	0	2	0	0	1	0	0	0	0	0	25
06:00	0	105	30	1	9	0	0	0	0	0	0	0	0	145
07:00	1	321	55	5	18	1	0	1	0	0	0	0	0	402
08:00	1	289	52	3	12	0	0	1	0	0	0	0	0	358
09:00	2	136	36	1	6	0	0	2	1	0	0	0	0	184
10:00	2	71	23	1	6	3	0	0	0	0	0	0	0	106
11:00	1	70	26	2	3	0	0	0	0	0	0	0	0	102
12 PM	1	84	25	0	2	0	0	2	0	0	0	0	0	114
13:00	1	79	30	3	4	0	0	1	0	0	0	0	0	118
14:00	0	99	22	2	5	0	0	1	0	0	0	0	0	129
15:00	2	97	35	4	4	0	0	1	0	0	0	0	0	143
16:00	1	112	21	0	3	1	0	0	0	0	0	0	0	138
17:00	0	119	26	0	3	0	0	0	0	0	0	0	0	148
18:00	0	107	21	0	3	1	0	0	0	0	0	0	0	132
19:00	1	39	10	0	3	0	0	0	0	0	0	0	0	53
20:00	0	27	8	0	0	0	0	0	0	0	0	0	0	35
21:00	0	22	0	0	0	0	0	0	0	0	0	0	0	22
22:00	0	10	5	0	0	0	0	0	0	0	0	0	0	15
23:00	0	7	1	0	0	0	0	0	0	0	0	0	0	8
Total	13	1821	433	22	84	6	0	10	1	0	0	0	0	2390
Percent	0.5%	76.2%	18.1%	0.9%	3.5%	0.3%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	09:00	07:00	07:00	07:00	07:00	10:00		09:00	09:00					07:00
Vol.	2	321	55	5	18	3		2	1					402
PM Peak	15:00	17:00	15:00	15:00	14:00	16:00		12:00						17:00
Vol.	2	119	35	4	5	1		2						148



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Old Bedford Road
south of Bedford Street (Route 62)
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 D Class
Site Code: TBA

SB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/15/1														
2	0	2	0	0	0	0	0	0	0	0	0	0	0	2
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	4	0	0	2	0	0	0	0	0	0	0	0	6
05:00	0	15	4	0	1	0	0	0	0	0	0	0	0	20
06:00	0	108	34	1	10	0	0	0	0	0	0	0	0	153
07:00	0	326	51	4	10	0	0	2	0	0	0	0	0	393
08:00	1	279	65	1	12	1	0	0	0	0	0	0	0	359
09:00	1	133	40	2	10	0	0	1	0	0	0	0	0	187
10:00	0	68	24	1	8	0	0	0	0	0	0	0	0	101
11:00	1	74	16	0	3	0	0	0	0	0	0	0	0	94
12 PM	2	97	28	0	7	0	0	1	1	0	0	0	0	136
13:00	1	83	21	1	5	0	0	0	0	0	0	0	0	111
14:00	0	81	16	3	3	0	0	0	0	0	0	0	0	103
15:00	0	110	40	5	3	0	0	0	0	0	0	0	0	158
16:00	1	103	24	1	4	0	0	0	0	0	0	0	0	133
17:00	1	141	25	0	3	3	0	0	0	0	0	0	0	173
18:00	2	113	21	1	3	0	0	0	0	0	0	0	0	140
19:00	0	54	8	0	2	0	0	0	0	0	0	0	0	64
20:00	0	30	4	0	0	0	0	0	0	0	0	0	0	34
21:00	0	19	7	0	1	0	0	0	0	0	0	0	0	27
22:00	0	14	1	0	0	0	0	0	0	0	0	0	0	15
23:00	0	7	2	0	0	0	0	0	0	0	0	0	0	9
Total	10	1862	431	20	87	4	0	4	1	0	0	0	0	2419
Percent	0.4%	77.0%	17.8%	0.8%	3.6%	0.2%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	08:00	07:00	08:00	07:00	08:00	08:00		07:00						07:00
Vol.	1	326	65	4	12	1		2						393
PM Peak	12:00	17:00	15:00	15:00	12:00	17:00		12:00	12:00					17:00
Vol.	2	141	40	5	7	3		1	1					173



PRECISION
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Old Bedford Road
south of Bedford Street (Route 62)
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 D Class
Site Code: TBA

SB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/16/1														
2	0	2	2	0	0	0	0	0	0	0	0	0	0	4
01:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
02:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	6	2	0	1	0	0	0	0	0	0	0	0	9
05:00	0	21	7	0	2	0	0	0	0	0	0	0	0	30
06:00	0	105	30	0	9	0	0	1	0	0	0	0	0	145
07:00	0	295	50	3	11	0	0	0	1	0	0	0	0	360
08:00	2	231	50	1	9	0	0	2	0	0	0	0	0	295
09:00	0	119	26	2	6	0	0	3	0	0	0	0	0	156
10:00	1	90	19	1	6	0	1	1	0	0	0	0	0	119
11:00	2	75	18	1	2	1	2	0	0	0	0	0	0	101
12 PM	4	77	18	0	5	1	0	0	0	0	0	0	0	105
13:00	2	90	17	2	7	0	0	1	0	0	0	0	0	119
14:00	0	79	24	2	3	1	0	3	0	0	0	0	0	112
15:00	0	111	33	2	2	0	0	0	1	0	0	0	0	149
16:00	0	100	31	1	5	0	0	0	0	0	0	0	0	137
17:00	2	115	21	1	3	1	0	0	0	0	0	0	0	143
18:00	1	76	13	0	1	0	0	0	0	0	0	0	0	91
19:00	0	39	0	0	0	0	0	0	0	0	0	0	0	39
20:00	0	31	8	0	1	0	0	0	0	0	0	0	0	40
21:00	0	19	3	0	1	0	0	0	0	0	0	0	0	23
22:00	0	19	1	0	0	0	0	0	0	0	0	0	0	20
23:00	0	3	0	0	0	0	0	0	0	0	0	0	0	3
Total	14	1706	373	16	74	4	3	11	2	0	0	0	0	2203
Percent	0.6%	77.4%	16.9%	0.7%	3.4%	0.2%	0.1%	0.5%	0.1%	0.0%	0.0%	0.0%	0.0%	
AM Peak	08:00	07:00	07:00	07:00	07:00	11:00	11:00	09:00	07:00					07:00
Vol.	2	295	50	3	11	1	2	3	1					360
PM Peak	12:00	17:00	15:00	13:00	13:00	12:00		14:00	15:00					15:00
Vol.	4	115	33	2	7	1		3	1					149



PRECISION
D A T A
INDUSTRIES, LLC

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Old Bedford Road
south of Bedford Street (Route 62)
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 D Class
Site Code: TBA

SB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/17/1														
2	0	4	1	0	0	0	0	0	0	0	0	0	0	5
01:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
02:00	0	0	1	0	0	0	0	0	0	0	0	0	0	1
03:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
04:00	0	1	1	0	1	0	0	0	0	0	0	0	0	3
05:00	0	3	3	0	1	0	0	0	0	0	0	0	0	7
06:00	0	10	9	0	0	0	0	0	0	0	0	0	0	19
07:00	0	36	12	0	6	0	0	0	0	0	0	0	0	54
08:00	0	56	17	0	3	0	0	0	0	0	0	0	0	76
09:00	1	95	21	0	3	1	0	0	0	0	0	0	0	121
10:00	3	96	21	0	6	0	0	0	0	0	0	0	0	126
11:00	5	80	19	0	2	0	0	0	0	0	0	0	0	106
12 PM	3	120	14	0	3	1	0	0	0	0	0	0	0	141
13:00	8	89	23	0	2	0	0	0	0	0	0	0	0	122
14:00	3	96	15	0	2	0	0	0	0	0	0	0	0	116
15:00	3	98	18	0	1	0	0	0	0	0	0	0	0	120
16:00	2	93	17	0	4	1	0	2	0	0	0	0	0	119
17:00	0	64	12	0	2	0	0	0	0	0	0	0	0	78
18:00	1	51	8	0	0	0	0	0	0	0	0	0	0	60
19:00	0	24	12	0	1	0	0	0	0	0	0	0	0	37
20:00	0	30	5	0	0	0	0	0	0	0	0	0	0	35
21:00	0	19	5	0	1	0	0	0	0	0	0	0	0	25
22:00	0	19	5	0	0	0	0	0	0	0	0	0	0	24
23:00	0	14	3	0	0	0	0	0	0	0	0	0	0	17
Total	29	1101	242	0	38	3	0	2	0	0	0	0	0	1415
Percent	2.0%	77.8%	17.1%	0.0%	2.7%	0.2%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	11:00	10:00	09:00		07:00	09:00								10:00
Vol.	5	96	21		6	1								126
PM Peak	13:00	12:00	13:00		16:00	12:00		16:00						12:00
Vol.	8	120	23		4	1		2						141



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SB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/18/1														
2	0	10	0	0	1	0	0	0	0	0	0	0	0	11
01:00	0	4	0	0	0	0	0	0	0	0	0	0	0	4
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	2	1	0	0	0	0	0	0	0	0	0	0	3
04:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
05:00	0	1	1	0	0	0	0	0	0	0	0	0	0	2
06:00	0	6	2	0	0	0	0	0	0	0	0	0	0	8
07:00	0	20	6	0	3	0	0	0	0	0	0	0	0	29
08:00	0	51	11	0	0	0	0	0	0	0	0	0	0	62
09:00	1	48	11	0	2	0	0	0	0	0	0	0	0	62
10:00	3	79	18	0	3	0	0	0	0	0	0	0	0	103
11:00	4	78	19	0	1	0	0	0	0	0	0	0	0	102
12 PM	4	95	24	0	6	0	0	0	0	0	0	0	0	129
13:00	5	109	21	0	4	0	0	0	0	0	0	0	0	139
14:00	3	95	19	0	4	0	0	0	0	0	0	0	0	121
15:00	3	92	8	0	2	0	0	0	0	0	0	0	0	105
16:00	1	75	13	0	1	0	0	0	0	0	0	0	0	90
17:00	0	42	9	0	2	0	0	1	0	0	0	0	0	54
18:00	0	47	10	0	1	0	0	0	0	0	0	0	0	58
19:00	0	27	18	0	1	0	0	0	0	0	0	0	0	46
20:00	0	23	2	0	0	0	0	0	0	0	0	0	0	25
21:00	0	8	4	0	0	0	0	0	0	0	0	0	0	12
22:00	0	10	3	0	2	0	0	0	0	0	0	0	0	15
23:00	0	1	1	0	0	0	0	0	0	0	0	0	0	2
Total	24	924	201	0	33	0	0	1	0	0	0	0	0	1183
Percent	2.0%	78.1%	17.0%	0.0%	2.8%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	11:00	10:00	11:00		07:00									10:00
Vol.	4	79	19		3									103
PM Peak	13:00	13:00	12:00		12:00			17:00						13:00
Vol.	5	109	24		6			1						139



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123082 D Class
Site Code: TBA

SB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/19/1														
2	0	3	2	0	0	0	0	0	0	0	0	0	0	5
01:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
02:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
03:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
04:00	0	4	0	0	1	0	0	0	0	0	0	0	0	5
05:00	0	18	5	0	2	0	0	0	0	0	0	0	0	25
06:00	0	101	30	0	11	0	0	0	0	0	0	0	0	142
07:00	1	305	47	4	13	0	0	0	0	0	0	0	0	370
08:00	0	291	58	4	12	2	0	0	3	0	0	0	0	370
09:00	4	155	38	1	12	0	0	4	1	0	0	0	0	215
10:00	3	70	17	0	2	0	0	1	0	0	0	0	0	93
11:00	0	56	18	0	6	0	0	0	0	0	0	0	0	80
12 PM	1	86	16	0	5	0	0	1	0	0	0	0	0	109
13:00	2	90	25	2	9	1	0	1	0	0	0	0	0	130
14:00	0	82	32	2	5	0	0	0	0	0	0	0	0	121
15:00	1	90	34	4	8	0	0	2	0	0	0	0	0	139
16:00	2	103	26	1	1	0	0	0	0	0	0	0	0	133
17:00	0	110	21	1	0	0	0	0	0	0	0	0	0	132
18:00	1	90	16	0	3	0	0	0	0	0	0	0	0	110
19:00	0	47	3	0	2	0	0	0	0	0	0	0	0	52
20:00	0	20	4	0	0	0	0	0	0	0	0	0	0	24
21:00	0	12	8	0	1	0	0	0	0	0	0	0	0	21
22:00	0	15	1	0	1	0	0	0	0	0	0	0	0	17
23:00	0	8	0	0	0	0	0	0	0	0	0	0	0	8
Total	15	1759	401	19	94	3	0	9	4	0	0	0	0	2304
Percent	0.7%	76.3%	17.4%	0.8%	4.1%	0.1%	0.0%	0.4%	0.2%	0.0%	0.0%	0.0%	0.0%	
AM Peak	09:00	07:00	08:00	07:00	07:00	08:00		09:00	08:00					07:00
Vol.	4	305	58	4	13	2		4	3					370
PM Peak	13:00	17:00	15:00	15:00	13:00	13:00		15:00						15:00
Vol.	2	110	34	4	9	1		2						139
Total		10931	2435	91	479	23	3	43	8	0	0	0	0	14123



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123082 D Class
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NB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/13/1														
2	0	1	1	0	0	0	0	0	0	0	0	0	0	2
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	5	1	0	0	0	0	0	0	0	0	0	0	6
05:00	0	4	2	0	0	0	0	0	0	0	0	0	0	6
06:00	0	24	5	1	1	0	0	0	0	0	0	0	0	31
07:00	0	107	20	1	2	0	0	1	0	0	0	0	0	131
08:00	0	156	32	0	2	0	0	0	0	0	0	0	0	190
09:00	1	83	18	0	2	0	0	0	0	0	0	0	0	104
10:00	0	62	24	0	5	1	0	1	0	0	0	0	0	93
11:00	0	103	26	0	1	0	0	1	0	0	0	0	0	131
12 PM	0	89	19	1	2	0	0	0	0	0	0	0	0	111
13:00	0	87	16	1	3	0	0	0	0	0	0	0	0	107
14:00	0	105	26	1	5	0	0	0	0	0	0	0	0	137
15:00	0	231	51	0	4	0	0	1	0	0	0	0	0	287
16:00	0	374	60	1	6	0	0	2	0	0	0	0	0	443
17:00	2	426	54	1	3	0	0	0	0	0	0	0	0	486
18:00	0	204	36	0	3	0	0	0	0	0	0	0	0	243
19:00	0	90	11	0	0	0	0	0	0	0	0	0	0	101
20:00	0	55	8	0	0	0	0	0	0	0	0	0	0	63
21:00	0	42	7	0	0	0	0	0	0	0	0	0	0	49
22:00	0	26	3	0	0	0	0	0	0	0	0	0	0	29
23:00	0	8	0	0	0	0	0	0	0	0	0	0	0	8
Total	3	2282	420	7	39	1	0	6	0	0	0	0	0	2758
Percent	0.1%	82.7%	15.2%	0.3%	1.4%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	09:00	08:00	08:00	06:00	10:00	10:00		07:00						08:00
Vol.	1	156	32	1	5	1		1						190
PM Peak	17:00	17:00	16:00	12:00	16:00			16:00						17:00
Vol.	2	426	60	1	6			2						486



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11/14/1														
2	0	3	1	0	0	0	0	0	0	0	0	0	0	4
01:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
02:00	0	1	1	0	0	0	0	0	0	0	0	0	0	2
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	4	1	0	0	0	0	0	0	0	0	0	0	5
05:00	0	4	2	0	0	0	0	0	0	0	0	0	0	6
06:00	0	31	6	1	1	0	0	0	0	0	0	0	0	39
07:00	0	97	22	1	2	1	0	0	1	0	0	0	0	124
08:00	0	159	38	3	5	0	0	0	0	0	0	0	0	205
09:00	0	86	32	1	3	0	0	0	2	0	0	0	0	124
10:00	0	65	18	0	3	2	0	0	0	0	0	0	0	88
11:00	2	97	21	1	4	1	0	0	0	0	0	0	0	126
12 PM	0	124	18	1	5	0	0	2	0	0	0	0	0	150
13:00	1	91	20	0	3	0	0	0	0	0	0	0	0	115
14:00	0	121	26	2	2	0	0	1	0	0	0	0	0	152
15:00	1	231	52	1	7	0	0	0	0	0	0	0	0	292
16:00	0	391	64	1	1	0	0	1	0	0	0	0	0	458
17:00	7	428	68	1	3	1	0	2	0	0	0	0	0	510
18:00	2	216	26	0	4	0	0	0	0	0	0	0	0	248
19:00	0	74	13	0	0	0	0	0	0	0	0	0	0	87
20:00	0	56	5	0	0	0	0	0	0	0	0	0	0	61
21:00	0	61	5	0	0	0	0	0	0	0	0	0	0	66
22:00	0	34	6	0	0	0	0	0	0	0	0	0	0	40
23:00	0	9	2	0	0	0	0	0	0	0	0	0	0	11
Total	13	2385	447	13	43	5	0	6	3	0	0	0	0	2915
Percent	0.4%	81.8%	15.3%	0.4%	1.5%	0.2%	0.0%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	
AM Peak	11:00	08:00	08:00	08:00	08:00	10:00			09:00					08:00
Vol.	2	159	38	3	5	2			2					205
PM Peak	17:00	17:00	17:00	14:00	15:00	17:00		12:00						17:00
Vol.	7	428	68	2	7	1		2						510



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11/15/1														
2	0	7	0	0	1	0	0	0	0	0	0	0	0	8
01:00	0	3	1	0	0	0	0	0	0	0	0	0	0	4
02:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
03:00	0	2	1	0	0	0	0	0	0	0	0	0	0	3
04:00	0	4	0	0	0	0	0	0	0	0	0	0	0	4
05:00	0	5	2	0	0	0	0	0	0	0	0	0	0	7
06:00	0	29	4	1	1	0	0	0	1	0	0	0	0	36
07:00	0	101	19	0	1	0	0	0	0	0	0	0	0	121
08:00	1	139	27	3	7	2	0	1	0	0	0	0	0	180
09:00	0	66	22	0	1	1	0	0	0	0	0	0	0	90
10:00	0	69	14	0	1	1	0	0	0	0	0	0	0	85
11:00	0	105	21	0	5	0	0	0	0	0	0	0	0	131
12 PM	0	134	19	1	1	0	0	0	0	0	0	0	0	155
13:00	0	88	9	2	3	0	0	1	0	0	0	0	0	103
14:00	0	164	32	2	3	0	0	1	0	0	0	0	0	202
15:00	1	243	48	3	4	0	0	3	0	0	0	0	0	302
16:00	1	391	72	0	6	2	0	0	0	0	0	0	0	472
17:00	8	425	69	1	6	0	0	1	0	0	0	0	0	510
18:00	4	246	26	0	0	0	0	1	0	0	0	0	0	277
19:00	0	101	7	0	1	0	0	0	0	0	0	0	0	109
20:00	0	73	5	0	2	0	0	0	0	0	0	0	0	80
21:00	0	38	5	0	1	0	0	0	0	0	0	0	0	44
22:00	0	31	3	0	1	0	0	0	0	0	0	0	0	35
23:00	0	20	4	0	1	0	0	0	0	0	0	0	0	25
Total	15	2485	410	13	46	6	0	8	1	0	0	0	0	2984
Percent	0.5%	83.3%	13.7%	0.4%	1.5%	0.2%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	08:00	08:00	08:00	08:00	08:00	08:00		08:00	06:00					08:00
Vol.	1	139	27	3	7	2		1	1					180
PM Peak	17:00	17:00	16:00	15:00	16:00	16:00		15:00						17:00
Vol.	8	425	72	3	6	2		3						510



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11/16/1														
2	0	10	0	0	0	0	0	0	0	0	0	0	0	10
01:00	0	2	1	0	0	0	0	0	0	0	0	0	0	3
02:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
03:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
04:00	0	5	3	0	0	0	0	0	0	0	0	0	0	8
05:00	0	5	3	0	0	0	0	0	0	0	0	0	0	8
06:00	0	29	3	1	0	1	0	0	1	0	0	0	0	35
07:00	0	97	21	2	1	1	0	0	0	0	0	0	0	122
08:00	1	146	29	1	3	0	0	0	0	0	0	0	0	180
09:00	0	73	23	2	3	0	0	0	0	0	0	0	0	101
10:00	1	82	12	1	1	1	0	1	1	0	0	0	0	100
11:00	0	104	17	1	3	1	0	0	0	0	0	0	0	126
12 PM	1	126	30	0	2	1	0	0	0	0	0	0	0	160
13:00	2	114	21	0	5	0	0	1	0	0	0	0	0	143
14:00	1	143	33	1	7	1	0	1	0	0	0	0	0	187
15:00	0	252	73	2	2	0	0	0	0	0	0	0	0	329
16:00	0	359	66	0	8	0	0	2	1	0	0	0	0	436
17:00	2	331	55	0	3	0	0	1	0	0	0	0	0	392
18:00	0	209	28	0	1	1	0	0	0	0	0	0	0	239
19:00	0	57	8	0	1	0	0	0	0	0	0	0	0	66
20:00	0	36	6	0	0	0	0	0	0	0	0	0	0	42
21:00	0	40	3	0	1	0	0	0	0	0	0	0	0	44
22:00	0	45	4	0	0	0	0	0	0	0	0	0	0	49
23:00	0	18	1	0	0	0	0	0	0	0	0	0	0	19
Total	8	2285	440	11	41	7	0	6	3	0	0	0	0	2801
Percent	0.3%	81.6%	15.7%	0.4%	1.5%	0.2%	0.0%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	
AM Peak	08:00	08:00	08:00	07:00	08:00	06:00		10:00	06:00					08:00
Vol.	1	146	29	2	3	1		1	1					180
PM Peak	13:00	16:00	15:00	15:00	16:00	12:00		16:00	16:00					16:00
Vol.	2	359	73	2	8	1		2	1					436



PRECISION
D A T A
INDUSTRIES, LLC

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Old Bedford Road
south of Bedford Street (Route 62)
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 D Class
Site Code: TBA

NB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/17/1														
2	0	13	0	0	0	0	0	0	0	0	0	0	0	13
01:00	0	6	0	0	0	0	0	0	0	0	0	0	0	6
02:00	0	3	2	0	0	0	0	0	0	0	0	0	0	5
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
05:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
06:00	0	12	3	0	0	0	0	0	0	0	0	0	0	15
07:00	0	15	3	1	0	0	0	1	0	0	0	0	0	20
08:00	1	39	9	2	1	1	0	0	0	0	0	0	0	53
09:00	1	77	15	0	3	0	0	0	0	0	0	0	0	96
10:00	2	115	16	0	3	0	0	0	0	0	0	0	0	136
11:00	5	107	24	0	3	0	0	0	0	0	0	0	0	139
12 PM	5	153	22	0	4	0	0	0	0	0	0	0	0	184
13:00	2	112	30	0	3	0	0	1	0	0	0	0	0	148
14:00	0	112	22	0	2	0	0	2	0	0	0	0	0	138
15:00	0	120	32	0	3	0	0	0	0	0	0	0	0	155
16:00	3	94	19	0	1	0	0	0	0	0	0	0	0	117
17:00	0	82	16	0	2	0	0	1	1	0	0	0	0	102
18:00	0	75	13	0	0	0	0	0	0	0	0	0	0	88
19:00	0	45	7	0	0	0	0	0	0	0	0	0	0	52
20:00	0	28	8	0	0	0	0	0	0	0	0	0	0	36
21:00	0	28	3	0	1	0	0	0	0	0	0	0	0	32
22:00	0	39	2	0	0	0	0	0	0	0	0	0	0	41
23:00	0	32	3	0	0	0	0	0	0	0	0	0	0	35
Total	19	1311	249	3	26	1	0	5	1	0	0	0	0	1615
Percent	1.2%	81.2%	15.4%	0.2%	1.6%	0.1%	0.0%	0.3%	0.1%	0.0%	0.0%	0.0%	0.0%	
AM Peak	11:00	10:00	11:00	08:00	09:00	08:00		07:00						11:00
Vol.	5	115	24	2	3	1		1						139
PM Peak	12:00	12:00	15:00		12:00			14:00	17:00					12:00
Vol.	5	153	32		4			2	1					184



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123082 D Class
Site Code: TBA

NB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/18/1														
2	0	8	0	0	1	0	0	0	0	0	0	0	0	9
01:00	0	5	1	0	0	0	0	0	0	0	0	0	0	6
02:00	0	4	0	0	0	0	0	0	0	0	0	0	0	4
03:00	0	4	0	0	0	0	0	0	0	0	0	0	0	4
04:00	0	1	1	0	0	0	0	0	0	0	0	0	0	2
05:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
06:00	0	6	0	0	0	0	0	0	0	0	0	0	0	6
07:00	0	18	7	0	2	0	0	0	0	0	0	0	0	27
08:00	0	32	11	0	0	0	0	1	0	0	0	0	0	44
09:00	0	55	8	0	1	0	0	0	0	0	0	0	0	64
10:00	3	67	16	0	0	0	0	0	0	0	0	0	0	86
11:00	1	92	9	0	0	0	0	0	0	0	0	0	0	102
12 PM	3	124	18	1	0	0	0	0	0	0	0	0	0	146
13:00	1	113	15	0	0	0	0	0	0	0	0	0	0	129
14:00	4	105	24	0	0	0	0	0	0	0	0	0	0	133
15:00	0	107	17	0	0	0	0	0	0	0	0	0	0	124
16:00	0	118	13	0	2	0	0	0	0	0	0	0	0	133
17:00	0	72	20	0	2	0	0	0	0	0	0	0	0	94
18:00	0	41	9	0	1	0	0	0	0	0	0	0	0	51
19:00	0	31	3	0	0	0	0	0	0	0	0	0	0	34
20:00	0	40	8	0	0	0	0	0	0	0	0	0	0	48
21:00	0	21	2	0	0	0	0	0	0	0	0	0	0	23
22:00	0	7	2	0	0	0	0	0	0	0	0	0	0	9
23:00	0	12	3	0	0	0	0	0	0	0	0	0	0	15
Total	12	1085	187	1	9	0	0	1	0	0	0	0	0	1295
Percent	0.9%	83.8%	14.4%	0.1%	0.7%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	10:00	11:00	10:00		07:00			08:00						11:00
Vol.	3	92	16		2			1						102
PM Peak	14:00	12:00	14:00	12:00	16:00									12:00
Vol.	4	124	24	1	2									146



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123082 D Class
Site Code: TBA

NB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/19/1														
2	0	3	0	0	1	0	0	0	0	0	0	0	0	4
01:00	0	3	0	0	0	0	0	0	0	0	0	0	0	3
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
04:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
05:00	0	5	2	0	0	0	0	0	0	0	0	0	0	7
06:00	2	23	3	0	2	0	0	0	0	0	0	0	0	30
07:00	2	95	22	1	1	0	0	0	0	0	0	0	0	121
08:00	0	143	37	2	1	0	0	0	0	0	0	0	0	183
09:00	0	72	21	1	1	0	0	0	2	0	0	0	0	97
10:00	0	73	16	0	5	1	0	0	1	0	0	0	0	96
11:00	0	91	20	1	3	0	0	0	0	0	0	0	0	115
12 PM	1	112	28	0	2	2	0	0	0	0	0	0	0	145
13:00	1	106	27	0	6	0	0	0	0	0	0	0	0	140
14:00	0	115	32	2	3	1	0	1	0	0	0	0	0	154
15:00	0	222	54	1	8	0	0	1	0	0	0	0	0	286
16:00	1	360	57	0	2	2	0	2	1	0	0	0	0	425
17:00	3	400	73	2	3	0	0	2	0	0	0	0	0	483
18:00	0	200	25	1	2	0	0	0	0	0	0	0	0	228
19:00	0	78	8	0	0	0	0	0	0	0	0	0	0	86
20:00	0	52	7	0	1	1	0	0	0	0	0	0	0	61
21:00	0	33	4	0	0	0	0	0	0	0	0	0	0	37
22:00	0	19	4	0	0	0	0	0	0	0	0	0	0	23
23:00	0	9	2	0	0	0	0	0	0	0	0	0	0	11
Total	10	2216	442	11	41	7	0	6	4	0	0	0	0	2737
Percent	0.4%	81.0%	16.1%	0.4%	1.5%	0.3%	0.0%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	
AM Peak	06:00	08:00	08:00	08:00	10:00	10:00			09:00					08:00
Vol.	2	143	37	2	5	1			2					183
PM Peak	17:00	17:00	17:00	14:00	15:00	12:00		16:00	16:00					17:00
Vol.	3	400	73	2	8	2		2	1					483
Total		14049	2595	59	245	27	0	38	12	0	0	0	0	17105



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Client: Toole Design Group/ C. Fink

123082 D Speed
Site Code: TBA

SB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/13/1																
2	0	0	0	0	1	1	0	0	0	0	0	0	0	2	*	34
01:00	0	0	0	0	2	0	0	0	0	0	0	0	0	2	*	32
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
03:00	0	0	0	0	0	0	1	0	0	0	0	0	0	1	*	42
04:00	0	0	0	0	3	1	0	0	0	0	0	0	0	4	32	33
05:00	0	0	0	3	8	12	3	0	0	0	0	0	0	26	38	35
06:00	0	0	0	6	61	52	12	1	0	0	0	0	0	132	38	35
07:00	0	1	9	11	134	182	28	1	1	0	0	0	0	367	38	35
08:00	0	0	6	21	121	141	26	1	1	0	0	0	0	317	38	35
09:00	0	0	0	6	72	112	23	2	0	0	0	0	0	215	39	36
10:00	0	0	0	3	40	33	14	1	0	0	0	0	0	91	39	35
11:00	0	0	2	6	34	25	5	1	0	0	0	0	0	73	38	34
12 PM	0	1	0	10	37	44	10	0	0	0	0	0	0	102	38	34
13:00	1	0	0	9	26	44	10	0	0	0	0	0	0	90	39	35
14:00	0	0	2	10	41	44	13	2	0	0	0	0	0	112	39	35
15:00	0	0	5	15	41	63	8	5	0	0	0	0	0	137	38	35
16:00	0	0	0	13	68	52	9	1	0	0	0	0	0	143	38	34
17:00	1	0	3	22	73	39	5	0	0	0	0	0	0	143	36	32
18:00	0	0	1	22	49	31	6	0	0	0	0	0	0	109	37	33
19:00	0	0	0	8	33	19	4	0	1	0	0	0	0	65	37	34
20:00	0	0	1	4	15	11	1	0	0	0	0	0	0	32	37	33
21:00	0	0	0	5	12	8	2	0	0	0	0	0	0	27	37	33
22:00	0	0	1	2	4	3	2	0	0	0	0	0	0	12	37	33
23:00	0	0	0	1	2	3	1	0	0	0	0	0	0	7	37	35

%	0.1%	0.1%	1.4%	8.0%	39.7%	41.6%	8.3%	0.7%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
AM Peak		07:00	07:00	08:00	07:00	07:00	07:00	09:00	07:00					07:00
Vol.		1	9	21	134	182	28	2	1					367
Midday Peak	13:00	12:00	11:00	12:00	14:00	12:00	14:00	14:00						14:00
Vol.	1	1	2	10	41	44	13	2						112
PM Peak	17:00		15:00	17:00	17:00	15:00	16:00	15:00	19:00					16:00
Vol.	1		5	22	73	63	9	5	1					143
% ile			15th Percentile :			29 MPH								
			50th Percentile :			34 MPH								
			85th Percentile :			38 MPH								
			95th Percentile :			41 MPH								

Stats

10 MPH Pace Speed : 30-39 MPH

Number in Pace : 1623

Percent in Pace : 73.5%

Number of Vehicles > 35 MPH : 934

Percent of Vehicles > 35 MPH : 42.3%

Mean Speed(Average) : 34 MPH



PRECISION
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123082 D Speed
Site Code: TBA

SB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
11/14/1																												
2	0	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	*	33
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
02:00	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	*	37
03:00	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	*	37
04:00	0	0	0	0	0	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	37	35
05:00	0	1	1	1	1	11	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	37	33
06:00	1	2	3	9	53	56	16	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	145	39	34
07:00	1	1	0	15	142	191	43	7	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	402	39	35
08:00	0	1	2	18	123	167	43	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	358	39	35
09:00	0	1	1	9	40	111	19	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	184	39	36
10:00	0	2	1	9	38	38	15	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	106	39	35
11:00	1	0	0	7	38	44	11	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	102	39	35
12 PM	0	3	1	3	28	51	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	114	40	36
13:00	0	0	3	10	28	56	17	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	118	40	36
14:00	0	0	1	8	53	56	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	129	38	35
15:00	0	0	3	12	56	52	19	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	143	39	35
16:00	1	0	0	15	49	57	15	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	138	38	34
17:00	0	0	7	24	74	38	3	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	148	36	33
18:00	0	0	0	9	65	44	13	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	132	38	34
19:00	1	0	0	4	20	21	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	53	39	34
20:00	0	0	0	2	18	13	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	37	34
21:00	0	0	0	2	8	8	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	39	35
22:00	0	0	0	0	5	7	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	39	37
23:00	0	0	0	0	2	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	40	38

%	0.2%	0.5%	1.0%	6.6%	35.8%	43.1%	11.3%	1.3%	0.2%	0.0%	0.0%	0.0%	0.0%
AM Peak Vol.	06:00	06:00	06:00	08:00	07:00	07:00	07:00	07:00	06:00	07:00	07:00		
	1	2	3	18	142	191	43	7	1	1	402		
Midday Peak Vol.	11:00	12:00	13:00	13:00	14:00	13:00	12:00	13:00	14:00				
	1	3	3	10	53	56	28	4	129				
PM Peak Vol.	16:00		17:00	17:00	17:00	16:00	15:00	15:00	17:00		17:00	17:00	
	1		7	24	74	57	19	1	1		1	148	
% ile			15th Percentile :		29 MPH								
			50th Percentile :		34 MPH								
			85th Percentile :		39 MPH								
			95th Percentile :		42 MPH								

Stats

10 MPH Pace Speed : 30-39 MPH

Number in Pace : 1704

Percent in Pace : 71.3%

Number of Vehicles > 35 MPH : 1121

Percent of Vehicles > 35 MPH : 46.9%

Mean Speed(Average) : 35 MPH



PRECISION
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P.O. Box 301 Berlin, MA 01503
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Email: datarequests@pdillc.com

123082 D Speed
Site Code: TBA

Old Bedford Road
south of Bedford Street (Route 62)
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

SB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/15/1																
2	0	0	0	0	1	1	0	0	0	0	0	0	0	2	*	34
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
02:00	0	0	0	0	0	1	0	0	0	0	0	0	0	1	*	37
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
04:00	0	0	0	0	4	0	2	0	0	0	0	0	0	6	32	35
05:00	0	0	0	0	8	8	3	0	1	0	0	0	0	20	39	36
06:00	0	0	1	8	46	80	16	2	0	0	0	0	0	153	39	36
07:00	1	0	0	17	127	202	41	3	2	0	0	0	0	393	39	36
08:00	1	0	10	16	124	163	41	3	1	0	0	0	0	359	39	35
09:00	0	1	1	10	50	98	26	1	0	0	0	0	0	187	39	36
10:00	0	0	1	5	32	46	13	4	0	0	0	0	0	101	40	36
11:00	0	1	0	3	35	44	8	2	1	0	0	0	0	94	38	35
12 PM	1	1	3	11	51	52	16	1	0	0	0	0	0	136	39	34
13:00	0	1	4	6	32	56	10	1	1	0	0	0	0	111	39	35
14:00	0	2	0	6	36	43	16	0	0	0	0	0	0	103	39	35
15:00	0	0	2	16	48	73	15	4	0	0	0	0	0	158	39	35
16:00	0	0	2	16	59	49	6	1	0	0	0	0	0	133	37	34
17:00	0	1	5	25	87	50	5	0	0	0	0	0	0	173	36	33
18:00	0	1	2	22	62	44	8	1	0	0	0	0	0	140	37	33
19:00	0	0	0	4	21	29	9	0	1	0	0	0	0	64	39	36
20:00	0	1	0	3	16	13	1	0	0	0	0	0	0	34	37	33
21:00	0	0	0	6	7	12	1	1	0	0	0	0	0	27	38	34
22:00	0	0	1	0	4	6	4	0	0	0	0	0	0	15	41	36
23:00	0	0	0	1	4	2	1	1	0	0	0	0	0	9	34	35

%	0.1%	0.4%	1.3%	7.2%	35.3%	44.3%	10.0%	1.0%	0.3%	0.0%	0.0%	0.0%	0.0%															
AM Peak Vol.	07:00	09:00	08:00	07:00	07:00	07:00	07:00	07:00	07:00																	07:00		
	1	1	10	17	127	202	41	3	2																	393		
Midday Peak Vol.	12:00	14:00	13:00	12:00	12:00	13:00	12:00	11:00	11:00																	12:00		
	1	2	4	11	51	56	16	2	1																	136		
PM Peak Vol.		17:00	17:00	17:00	17:00	15:00	15:00	15:00	19:00																	17:00		
		1	5	25	87	73	15	4	1																	173		
% ile				15th Percentile :		29 MPH																						
				50th Percentile :		34 MPH																						
				85th Percentile :		39 MPH																						
				95th Percentile :		42 MPH																						

Stats

10 MPH Pace Speed : 30-39 MPH

Number in Pace : 1740

Percent in Pace : 71.9%

Number of Vehicles > 35 MPH : 1120

Percent of Vehicles > 35 MPH : 46.3%

Mean Speed(Average) : 35 MPH



PRECISION
D A T A
INDUSTRIES, LLC

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Old Bedford Road
south of Bedford Street (Route 62)
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 D Speed
Site Code: TBA

SB

Start Time	14	15	20	25	30	35	40	45	50	55	60	65	70	Total	85th % ile	Ave Speed
11/16/1																
2	0	0	0	0	3	1	0	0	0	0	0	0	0	4	32	33
01:00	0	0	0	1	1	0	0	0	0	0	0	0	0	2	*	29
02:00	0	0	0	1	0	0	0	0	0	0	0	0	0	1	*	27
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
04:00	0	0	0	1	4	3	1	0	0	0	0	0	0	9	36	34
05:00	0	0	1	1	13	12	2	1	0	0	0	0	0	30	37	35
06:00	0	0	0	3	47	74	19	1	1	0	0	0	0	145	39	36
07:00	0	0	0	12	147	156	40	4	1	0	0	0	0	360	39	35
08:00	3	4	1	15	87	143	38	4	0	0	0	0	0	295	39	35
09:00	1	0	1	5	51	72	24	2	0	0	0	0	0	156	39	36
10:00	0	0	1	12	38	49	17	2	0	0	0	0	0	119	39	35
11:00	1	2	0	7	30	45	14	2	0	0	0	0	0	101	39	35
12 PM	1	4	4	5	41	39	10	1	0	0	0	0	0	105	38	33
13:00	1	2	1	13	53	34	11	4	0	0	0	0	0	119	38	33
14:00	0	1	3	18	33	51	6	0	0	0	0	0	0	112	38	34
15:00	1	1	3	11	59	56	15	3	0	0	0	0	0	149	39	34
16:00	0	0	3	13	61	49	10	1	0	0	0	0	0	137	38	34
17:00	0	0	2	16	72	38	13	2	0	0	0	0	0	143	38	34
18:00	1	0	0	9	36	32	11	2	0	0	0	0	0	91	39	34
19:00	0	1	0	3	19	13	3	0	0	0	0	0	0	39	37	33
20:00	1	0	0	6	16	16	1	0	0	0	0	0	0	40	37	32
21:00	0	0	0	5	11	4	3	0	0	0	0	0	0	23	38	33
22:00	0	0	1	0	6	10	3	0	0	0	0	0	0	20	39	36
23:00	0	0	0	0	2	1	0	0	0	0	0	0	0	3	*	34

%	0.5%	0.7%	1.0%	7.1%	37.7%	40.8%	10.9%	1.3%	0.1%	0.0%	0.0%	0.0%	0.0%			
AM Peak	08:00	08:00	05:00	08:00	07:00	07:00	07:00	07:00	06:00					07:00		
Vol.	3	4	1	15	147	156	40	4	1					360		
Midday Peak	11:00	12:00	12:00	14:00	13:00	14:00	11:00	13:00						13:00		
Vol.	1	4	4	18	53	51	14	4						119		
PM Peak	15:00	15:00	15:00	17:00	17:00	15:00	15:00	15:00						15:00		
Vol.	1	1	3	16	72	56	15	3						149		
% ile			15th Percentile :			29 MPH										
			50th Percentile :			34 MPH										
			85th Percentile :			39 MPH										
			95th Percentile :			42 MPH										

Stats

10 MPH Pace Speed : 30-39 MPH

Number in Pace : 1558

Percent in Pace : 70.7%

Number of Vehicles > 35 MPH : 981

Percent of Vehicles > 35 MPH : 44.5%

Mean Speed(Average) : 35 MPH



PRECISION
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City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 D Speed
Site Code: TBA

SB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/17/1																
2	0	0	0	0	1	3	1	0	0	0	0	0	0	5	37	37
01:00	0	0	0	1	0	0	0	0	0	0	0	0	0	1	*	27
02:00	0	0	0	0	1	0	0	0	0	0	0	0	0	1	*	32
03:00	0	0	0	0	0	1	1	0	0	0	0	0	0	2	*	39
04:00	0	0	0	0	1	1	1	0	0	0	0	0	0	3	*	37
05:00	0	0	0	0	4	2	0	1	0	0	0	0	0	7	34	36
06:00	0	0	0	1	8	6	3	1	0	0	0	0	0	19	40	36
07:00	0	1	0	5	9	28	8	1	2	0	0	0	0	54	39	36
08:00	1	1	3	2	24	27	13	5	0	0	0	0	0	76	41	35
09:00	3	10	20	41	35	10	2	0	0	0	0	0	0	121	33	26
10:00	0	6	22	35	44	17	2	0	0	0	0	0	0	126	34	29
11:00	0	7	34	35	27	3	0	0	0	0	0	0	0	106	31	26
12 PM	3	10	26	36	59	6	1	0	0	0	0	0	0	141	32	27
13:00	0	8	15	33	51	12	3	0	0	0	0	0	0	122	34	29
14:00	0	2	3	7	63	34	6	1	0	0	0	0	0	116	37	33
15:00	1	2	3	4	49	48	12	0	1	0	0	0	0	120	38	34
16:00	0	2	4	14	33	55	8	3	0	0	0	0	0	119	38	34
17:00	0	0	1	9	32	28	6	2	0	0	0	0	0	78	38	34
18:00	0	1	1	8	19	22	7	2	0	0	0	0	0	60	39	34
19:00	0	0	0	1	20	12	4	0	0	0	0	0	0	37	38	35
20:00	0	0	1	4	10	15	5	0	0	0	0	0	0	35	39	35
21:00	0	0	2	3	12	6	2	0	0	0	0	0	0	25	37	33
22:00	1	0	0	2	8	8	5	0	0	0	0	0	0	24	40	34
23:00	0	0	1	2	10	4	0	0	0	0	0	0	0	17	35	32

%	0.6%	3.5%	9.6%	17.2%	36.7%	24.6%	6.4%	1.1%	0.2%	0.0%	0.0%	0.0%	0.0%															
AM Peak	09:00	09:00	09:00	09:00	09:00	07:00	08:00	08:00	07:00																	09:00		
Vol.	3	10	20	41	35	28	13	5	2																	121		
Midday Peak	12:00	12:00	11:00	12:00	14:00	14:00	14:00	14:00																		12:00		
Vol.	3	10	34	36	63	34	6	1																		141		
PM Peak	15:00	15:00	16:00	16:00	15:00	16:00	15:00	16:00	15:00																	15:00		
Vol.	1	2	4	14	49	55	12	3	1																	120		
% ile			15th Percentile :			23 MPH																						
			50th Percentile :			31 MPH																						
			85th Percentile :			37 MPH																						
			95th Percentile :			41 MPH																						

Stats

10 MPH Pace Speed : 28-37 MPH

Number in Pace : 808

Percent in Pace : 57.1%

Number of Vehicles > 35 MPH : 386

Percent of Vehicles > 35 MPH : 27.3%

Mean Speed(Average) : 31 MPH



PRECISION
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123082 D Speed
Site Code: TBA

SB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/18/1																
2	0	0	0	3	6	1	1	0	0	0	0	0	0	11	33	32
01:00	0	0	0	0	2	2	0	0	0	0	0	0	0	4	*	34
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
03:00	0	0	0	0	0	1	1	0	0	1	0	0	0	3	*	45
04:00	0	0	0	0	0	1	0	0	0	0	0	0	0	1	*	37
05:00	0	0	0	0	1	0	1	0	0	0	0	0	0	2	*	37
06:00	0	0	0	2	0	4	2	0	0	0	0	0	0	8	39	36
07:00	0	0	2	3	7	12	4	1	0	0	0	0	0	29	39	35
08:00	0	0	1	2	19	29	11	0	0	0	0	0	0	62	40	36
09:00	1	1	0	4	17	28	11	0	0	0	0	0	0	62	40	35
10:00	0	4	0	7	36	45	9	1	1	0	0	0	0	103	38	34
11:00	0	3	2	9	32	48	8	0	0	0	0	0	0	102	38	34
12 PM	1	4	1	7	54	50	12	0	0	0	0	0	0	129	38	33
13:00	1	4	2	8	35	73	14	2	0	0	0	0	0	139	39	34
14:00	0	3	0	11	39	50	16	2	0	0	0	0	0	121	39	35
15:00	1	1	3	16	37	39	8	0	0	0	0	0	0	105	38	33
16:00	0	1	0	7	48	22	11	1	0	0	0	0	0	90	38	34
17:00	0	1	2	4	27	14	5	1	0	0	0	0	0	54	38	33
18:00	0	0	0	7	27	18	5	1	0	0	0	0	0	58	38	34
19:00	0	0	1	3	8	23	8	3	0	0	0	0	0	46	41	37
20:00	0	0	0	2	11	11	0	1	0	0	0	0	0	25	37	34
21:00	0	0	0	1	6	4	0	1	0	0	0	0	0	12	36	35
22:00	0	0	0	1	7	7	0	0	0	0	0	0	0	15	38	34
23:00	0	0	0	0	1	1	0	0	0	0	0	0	0	2	*	34

%	0.3%	1.9%	1.2%	8.2%	35.5%	40.8%	10.7%	1.2%	0.1%	0.1%	0.0%	0.0%	0.0%															
AM Peak Vol.	09:00	09:00	07:00	09:00	08:00	08:00	08:00	07:00		03:00																08:00		
	1	1	2	4	19	29	11	1		1																62		
Midday Peak Vol.	12:00	12:00	11:00	14:00	12:00	13:00	14:00	13:00																		13:00		
	1	4	2	11	54	73	16	2																		139		
PM Peak Vol.	15:00	15:00	15:00	15:00	16:00	15:00	16:00	19:00																		15:00		
	1	1	3	16	48	39	11	3																		105		
% ile				15th Percentile :		28 MPH																						
				50th Percentile :		34 MPH																						
				85th Percentile :		39 MPH																						
				95th Percentile :		42 MPH																						

Stats

10 MPH Pace Speed : 30-39 MPH

Number in Pace : 812

Percent in Pace : 68.6%

Number of Vehicles > 35 MPH : 521

Percent of Vehicles > 35 MPH : 44.0%

Mean Speed(Average) : 34 MPH



PRECISION
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123082 D Speed
Site Code: TBA

SB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/19/1																
2	0	0	0	0	3	2	0	0	0	0	0	0	0	5	33	34
01:00	0	0	0	1	0	0	0	0	0	0	0	0	0	1	*	27
02:00	0	0	0	0	1	0	0	0	0	0	0	0	0	1	*	32
03:00	0	0	0	0	0	1	0	0	0	0	0	0	0	1	*	37
04:00	0	0	0	1	2	1	1	0	0	0	0	0	0	5	*	34
05:00	0	0	1	0	8	14	2	0	0	0	0	0	0	25	38	35
06:00	0	0	1	8	54	62	15	2	0	0	0	0	0	142	39	35
07:00	0	0	5	22	131	160	49	2	1	0	0	0	0	370	39	35
08:00	0	2	2	14	138	174	36	3	1	0	0	0	0	370	39	35
09:00	1	2	0	12	54	109	36	1	0	0	0	0	0	215	40	36
10:00	1	2	1	10	25	38	14	1	1	0	0	0	0	93	39	34
11:00	0	0	0	4	28	37	11	0	0	0	0	0	0	80	39	35
12 PM	0	1	0	9	45	44	9	1	0	0	0	0	0	109	38	34
13:00	0	1	2	8	57	47	15	0	0	0	0	0	0	130	38	34
14:00	0	0	0	7	34	61	17	0	1	0	0	1	0	121	39	36
15:00	0	1	1	12	61	51	12	1	0	0	0	0	0	139	38	34
16:00	0	0	2	10	54	60	6	1	0	0	0	0	0	133	38	34
17:00	0	0	0	28	63	33	6	1	1	0	0	0	0	132	36	33
18:00	1	1	0	13	44	44	4	3	0	0	0	0	0	110	38	34
19:00	0	0	0	2	17	29	4	0	0	0	0	0	0	52	38	35
20:00	0	0	0	2	13	4	4	0	1	0	0	0	0	24	39	35
21:00	0	0	0	2	12	5	2	0	0	0	0	0	0	21	38	34
22:00	0	0	0	2	6	5	4	0	0	0	0	0	0	17	40	35
23:00	1	0	1	0	3	1	2	0	0	0	0	0	0	8	31	29

%	0.2%	0.4%	0.7%	7.2%	37.0%	42.6%	10.8%	0.7%	0.3%	0.0%	0.0%	0.0%	0.0%	
AM Peak	09:00	08:00	07:00	07:00	08:00	08:00	07:00	08:00	07:00					07:00
Vol.	1	2	5	22	138	174	49	3	1					370
Midday Peak		12:00	13:00	12:00	13:00	14:00	14:00	12:00	14:00				14:00	13:00
Vol.		1	2	9	57	61	17	1	1			1		130
PM Peak	18:00	15:00	16:00	17:00	17:00	16:00	15:00	18:00	17:00					15:00
Vol.	1	1	2	28	63	60	12	3	1					139
% ile			15th Percentile :		29 MPH									
			50th Percentile :		34 MPH									
			85th Percentile :		39 MPH									
			95th Percentile :		42 MPH									

Stats

10 MPH Pace Speed : 30-39 MPH

Number in Pace : 1659

Percent in Pace : 72.0%

Number of Vehicles > 35 MPH : 1049

Percent of Vehicles > 35 MPH : 45.5%

Mean Speed(Average) : 35 MPH



PRECISION
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123082 D Speed
Site Code: TBA

NB

Start Time	14	15	20	25	30	35	40	45	50	55	60	65	70	Total	85th % ile	Ave Speed
11/13/1																
2	0	0	0	0	0	2	0	0	0	0	0	0	0	2	*	37
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
04:00	0	0	0	1	0	2	2	1	0	0	0	0	0	6	*	39
05:00	0	0	0	1	1	3	1	0	0	0	0	0	0	6	37	35
06:00	0	0	2	5	11	13	0	0	0	0	0	0	0	31	37	33
07:00	2	0	2	4	53	60	8	2	0	0	0	0	0	131	38	34
08:00	0	0	0	4	70	91	23	2	0	0	0	0	0	190	39	36
09:00	0	0	0	3	34	54	12	1	0	0	0	0	0	104	39	36
10:00	0	0	5	9	26	39	14	0	0	0	0	0	0	93	39	35
11:00	0	0	2	4	50	54	18	3	0	0	0	0	0	131	39	35
12 PM	0	0	0	1	44	51	12	3	0	0	0	0	0	111	39	36
13:00	0	0	1	7	40	46	10	2	1	0	0	0	0	107	38	35
14:00	0	0	1	4	55	64	11	2	0	0	0	0	0	137	38	35
15:00	0	0	3	24	95	132	31	2	0	0	0	0	0	287	39	35
16:00	0	0	10	99	220	108	6	0	0	0	0	0	0	443	36	32
17:00	6	14	50	138	215	59	4	0	0	0	0	0	0	486	34	29
18:00	0	0	1	37	139	59	7	0	0	0	0	0	0	243	36	33
19:00	0	0	0	11	46	29	15	0	0	0	0	0	0	101	39	34
20:00	0	0	0	7	23	25	5	3	0	0	0	0	0	63	39	35
21:00	0	0	0	5	15	24	3	2	0	0	0	0	0	49	38	35
22:00	0	0	0	2	9	14	3	1	0	0	0	0	0	29	38	36
23:00	0	0	0	2	3	3	0	0	0	0	0	0	0	8	35	33

%	0.3%	0.5%	2.8%	13.3%	41.7%	33.8%	6.7%	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%			
AM Peak	07:00		06:00	06:00	08:00	08:00	08:00	07:00						08:00		
Vol.	2		2	5	70	91	23	2						190		
Midday Peak			11:00	13:00	14:00	14:00	11:00	11:00	13:00					14:00		
Vol.			2	7	55	64	18	3	1					137		
PM Peak	17:00	17:00	17:00	17:00	16:00	15:00	15:00	20:00						17:00		
Vol.	6	14	50	138	220	132	31	3						486		
% ile			15th Percentile :			27 MPH										
			50th Percentile :			32 MPH										
			85th Percentile :			38 MPH										
			95th Percentile :			40 MPH										

Stats

10 MPH Pace Speed :	29-38 MPH
Number in Pace :	1898
Percent in Pace :	68.8%
Number of Vehicles > 35 MPH :	960
Percent of Vehicles > 35 MPH :	34.8%
Mean Speed(Average) :	33 MPH



P.O.Box 301 Berlin, MA 01503
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Email: datarequests@pdillc.com

123082 D Speed
Site Code: TBA

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/14/1																
2	0	0	0	0	3	1	0	0	0	0	0	0	0	4	32	33
01:00	0	0	0	0	0	1	1	0	0	0	0	0	0	2	*	39
02:00	0	0	0	0	1	0	1	0	0	0	0	0	0	2	*	37
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
04:00	0	0	0	0	1	3	0	1	0	0	0	0	0	5	36	38
05:00	0	0	0	1	3	2	0	0	0	0	0	0	0	6	33	33
06:00	0	1	1	5	9	20	2	1	0	0	0	0	0	39	38	34
07:00	0	0	0	7	44	58	15	0	0	0	0	0	0	124	39	35
08:00	0	0	3	7	71	108	16	0	0	0	0	0	0	205	38	35
09:00	0	0	1	4	51	58	8	1	1	0	0	0	0	124	38	35
10:00	0	0	0	4	17	54	13	0	0	0	0	0	0	88	39	36
11:00	1	2	0	4	47	58	13	1	0	0	0	0	0	126	39	35
12 PM	0	0	1	14	58	65	10	2	0	0	0	0	0	150	38	34
13:00	0	0	1	3	33	60	16	2	0	0	0	0	0	115	39	36
14:00	0	2	2	4	67	60	14	2	1	0	0	0	0	152	38	35
15:00	0	2	3	29	127	107	19	4	1	0	0	0	0	292	38	34
16:00	0	0	8	60	229	143	17	1	0	0	0	0	0	458	37	33
17:00	26	9	57	117	236	62	3	0	0	0	0	0	0	510	34	28
18:00	0	0	2	39	124	74	9	0	0	0	0	0	0	248	37	33
19:00	0	0	0	13	36	29	9	0	0	0	0	0	0	87	38	34
20:00	0	0	0	6	31	15	7	2	0	0	0	0	0	61	39	34
21:00	1	0	1	4	29	26	4	0	1	0	0	0	0	66	38	34
22:00	0	0	1	5	13	17	4	0	0	0	0	0	0	40	38	34
23:00	0	0	0	2	6	2	0	1	0	0	0	0	0	11	34	33

% iles	15th Percentile :	27 MPH
	50th Percentile :	33 MPH
	85th Percentile :	37 MPH
	95th Percentile :	40 MPH

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PRECISION
D A T A
INDUSTRIES, LLC

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Old Bedford Road
south of Bedford Street (Route 62)
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 D Speed
Site Code: TBA

NB

Start Time	14	15	20	25	30	35	40	45	50	55	60	65	70	Total	85th % ile	Ave Speed
11/15/1																
2	0	0	0	0	5	3	0	0	0	0	0	0	0	8	35	34
01:00	0	0	0	0	0	4	0	0	0	0	0	0	0	4	37	37
02:00	0	0	0	0	1	0	0	0	0	0	0	0	0	1	*	32
03:00	0	0	0	1	1	1	0	0	0	0	0	0	0	3	*	32
04:00	0	0	0	0	0	2	1	0	1	0	0	0	0	4	*	42
05:00	0	0	0	2	3	2	0	0	0	0	0	0	0	7	33	32
06:00	0	0	1	6	7	20	2	0	0	0	0	0	0	36	38	34
07:00	0	0	0	6	40	58	16	1	0	0	0	0	0	121	39	36
08:00	1	0	2	9	58	82	25	2	1	0	0	0	0	180	39	35
09:00	0	0	0	5	30	44	11	0	0	0	0	0	0	90	39	35
10:00	0	2	1	4	31	32	14	1	0	0	0	0	0	85	40	35
11:00	0	0	3	2	33	75	16	2	0	0	0	0	0	131	39	36
12 PM	0	0	0	10	38	79	26	2	0	0	0	0	0	155	39	36
13:00	0	0	1	2	25	55	19	1	0	0	0	0	0	103	40	36
14:00	2	3	2	19	81	76	17	2	0	0	0	0	0	202	38	34
15:00	0	1	3	51	140	92	13	2	0	0	0	0	0	302	37	33
16:00	0	0	9	105	247	103	7	1	0	0	0	0	0	472	35	32
17:00	21	15	56	114	228	72	4	0	0	0	0	0	0	510	34	28
18:00	0	0	5	37	146	81	8	0	0	0	0	0	0	277	36	33
19:00	0	0	0	10	34	53	12	0	0	0	0	0	0	109	38	35
20:00	0	0	1	7	45	21	6	0	0	0	0	0	0	80	37	34
21:00	0	0	0	2	14	21	7	0	0	0	0	0	0	44	39	36
22:00	0	0	0	2	15	14	3	1	0	0	0	0	0	35	38	35
23:00	0	0	1	2	10	9	3	0	0	0	0	0	0	25	38	34

%	0.8%	0.7%	2.8%	13.3%	41.3%	33.5%	7.0%	0.5%	0.1%	0.0%	0.0%	0.0%	0.0%			
AM Peak	08:00		08:00	08:00	08:00	08:00	08:00	08:00	04:00					08:00		
Vol.	1		2	9	58	82	25	2	1					180		
Midday Peak	14:00	14:00	11:00	14:00	14:00	12:00	12:00	11:00						14:00		
Vol.	2	3	3	19	81	79	26	2						202		
PM Peak	17:00	17:00	17:00	17:00	16:00	16:00	15:00	15:00						17:00		
Vol.	21	15	56	114	247	103	13	2						510		
% ile			15th Percentile :			27 MPH										
			50th Percentile :			32 MPH										
			85th Percentile :			38 MPH										
			95th Percentile :			40 MPH										

Stats

10 MPH Pace Speed : 29-38 MPH

Number in Pace : 2027

Percent in Pace : 67.9%

Number of Vehicles > 35 MPH : 1026

Percent of Vehicles > 35 MPH : 34.4%

Mean Speed(Average) : 33 MPH



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NB

[illegible]

%	0.2%	0.6%	1.2%	9.2%	41.4%	38.5%	8.0%	0.6%	0.1%	0.0%	0.0%	0.0%	0.0%
AM Peak Vol.		06:00	09:00	06:00	08:00	08:00	08:00	07:00	04:00				08:00
		1	2	6	67	80	24	2	1				180
Midday Peak Vol.		14:00	13:00	12:00	14:00	12:00	14:00	11:00					14:00
		3	3	9	71	83	25	2					187
PM Peak Vol.	17:00	17:00	17:00	17:00	16:00	15:00	15:00	15:00					16:00
	3	6	14	74	235	160	28	3					436
%iles			15th Percentile :			28 MPH							
			50th Percentile :			33 MPH							
			85th Percentile :			38 MPH							
			95th Percentile :			41 MPH							

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PRECISION
D A T A
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Old Bedford Road
south of Bedford Street (Route 62)
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 D Speed
Site Code: TBA

NB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
11/17/1																												
2	0	0	0	1	2	7	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	35	32
01:00	0	0	0	0	1	3	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	32	35
02:00	0	1	0	0	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	*	35
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
04:00	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	*	37
05:00	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	*	42
06:00	0	0	0	0	1	7	3	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	15	40	35
07:00	0	0	0	0	2	3	11	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	38	37
08:00	1	0	2	4	15	25	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	53	39	34
09:00	1	1	0	18	38	32	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96	37	33
10:00	1	1	4	22	54	47	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	136	37	33
11:00	1	7	4	24	60	31	9	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	139	37	31
12 PM	0	2	2	40	94	40	5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	184	36	32
13:00	1	1	3	23	67	45	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	148	37	33
14:00	0	2	2	19	46	59	8	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	138	38	34
15:00	0	0	2	9	61	67	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	155	38	35
16:00	0	3	2	2	49	43	15	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	117	39	35
17:00	0	0	2	11	49	29	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	102	38	34
18:00	0	0	0	4	43	34	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	88	38	35
19:00	0	0	3	5	22	18	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	52	37	33
20:00	0	0	1	4	16	9	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	39	34
21:00	0	0	0	6	7	14	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32	39	35
22:00	0	0	0	6	17	15	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41	37	34
23:00	0	0	1	1	14	15	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	37	35

%	0.3%	1.1%	1.8%	12.6%	41.6%	33.7%	7.6%	1.1%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AM Peak	08:00	02:00	08:00	09:00	09:00	09:00	08:00	07:00																		09:00		
Vol.	1	1	2	18	38	32	6	2																		96		
Midday Peak	11:00	11:00	11:00	12:00	12:00	14:00	11:00	11:00	12:00																	12:00		
Vol.	1	7	4	40	94	59	9	3	1																	184		
PM Peak		16:00	19:00	17:00	15:00	15:00	15:00	16:00	22:00																	15:00		
Vol.		3	3	11	61	67	16	3	1																	155		
% ile				15th Percentile :		27 MPH																						
				50th Percentile :		33 MPH																						
				85th Percentile :		38 MPH																						
				95th Percentile :		41 MPH																						

Stats

10 MPH Pace Speed : 29-38 MPH

Number in Pace : 1104

Percent in Pace : 68.4%

Number of Vehicles > 35 MPH : 579

Percent of Vehicles > 35 MPH : 35.8%

Mean Speed(Average) : 33 MPH



PRECISION
D A T A
INDUSTRIES, LLC

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Old Bedford Road
south of Bedford Street (Route 62)
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 D Speed
Site Code: TBA

NB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/18/1																
2	0	0	0	0	2	6	1	0	0	0	0	0	0	9	38	36
01:00	0	0	0	1	4	1	0	0	0	0	0	0	0	6	33	32
02:00	0	0	0	1	1	2	0	0	0	0	0	0	0	4	*	33
03:00	0	0	0	0	2	0	0	0	1	1	0	0	0	4	*	43
04:00	0	0	0	0	0	0	1	1	0	0	0	0	0	2	*	44
05:00	0	0	0	0	1	1	0	0	0	0	0	0	0	2	*	34
06:00	0	0	0	0	1	4	0	0	1	0	0	0	0	6	37	39
07:00	0	0	1	0	10	9	5	2	0	0	0	0	0	27	42	36
08:00	0	0	0	1	12	21	9	1	0	0	0	0	0	44	40	37
09:00	0	0	1	2	23	29	8	1	0	0	0	0	0	64	39	35
10:00	0	2	3	0	14	48	17	2	0	0	0	0	0	86	40	36
11:00	1	1	4	3	28	51	13	1	0	0	0	0	0	102	39	35
12 PM	0	2	2	9	38	66	27	2	0	0	0	0	0	146	40	36
13:00	0	2	0	7	36	71	12	1	0	0	0	0	0	129	39	35
14:00	1	0	0	9	41	65	16	1	0	0	0	0	0	133	39	35
15:00	0	0	0	6	45	58	14	1	0	0	0	0	0	124	39	35
16:00	1	0	1	7	55	60	6	3	0	0	0	0	0	133	38	34
17:00	0	0	2	9	37	37	9	0	0	0	0	0	0	94	38	34
18:00	0	0	0	6	17	19	8	1	0	0	0	0	0	51	39	35
19:00	1	0	2	1	10	14	6	0	0	0	0	0	0	34	39	34
20:00	0	0	1	3	20	21	3	0	0	0	0	0	0	48	38	34
21:00	1	0	0	1	4	10	4	3	0	0	0	0	0	23	43	36
22:00	0	0	0	1	4	4	0	0	0	0	0	0	0	9	36	34
23:00	0	0	0	0	3	6	4	0	2	0	0	0	0	15	41	39

%	0.4%	0.5%	1.3%	5.2%	31.5%	46.6%	12.6%	1.5%	0.3%	0.1%	0.0%	0.0%	0.0%															
AM Peak Vol.			07:00	09:00	09:00	09:00	08:00	07:00	03:00	03:00																09:00		
			1	2	23	29	9	2	1	1																64		
Midday Peak Vol.	11:00	12:00	11:00	12:00	14:00	13:00	12:00	12:00																		12:00		
	1	2	4	9	41	71	27	2																		146		
PM Peak Vol.	16:00		17:00	17:00	16:00	16:00	15:00	16:00	23:00																	16:00		
	1		2	9	55	60	14	3	2																	133		
% ile			15th Percentile :			30 MPH																						
			50th Percentile :			35 MPH																						
			85th Percentile :			39 MPH																						
			95th Percentile :			42 MPH																						

Stats

10 MPH Pace Speed : 31-40 MPH

Number in Pace : 926

Percent in Pace : 71.5%

Number of Vehicles > 35 MPH : 659

Percent of Vehicles > 35 MPH : 50.9%

Mean Speed(Average) : 35 MPH



PRECISION
D A T A
INDUSTRIES, LLC

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Old Bedford Road
south of Bedford Street (Route 62)
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 D Speed
Site Code: TBA

NB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
11/19/1																												
2	0	0	0	0	0	0	0	1	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	4	*	38
01:00	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	*	34
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
03:00	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	*	42
04:00	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	*	42
05:00	0	0	0	0	1	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	35	33
06:00	0	0	1	1	8	16	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	39	36
07:00	0	0	1	9	40	50	20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	121	39	35
08:00	0	1	1	6	58	86	26	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	183	40	36
09:00	0	0	0	1	37	44	13	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	97	39	36
10:00	0	1	1	4	22	51	14	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96	39	36
11:00	0	0	1	5	42	54	12	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	115	39	35
12 PM	1	1	0	12	42	69	17	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	145	39	35
13:00	1	0	4	11	41	68	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	140	39	35
14:00	0	0	2	6	53	79	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	154	38	35
15:00	0	0	0	8	97	141	36	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	286	39	36
16:00	0	0	0	38	218	152	16	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	425	37	34
17:00	2	2	20	159	240	56	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	483	34	30
18:00	1	0	2	18	117	83	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	228	37	33
19:00	0	0	1	9	34	31	9	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	86	39	35
20:00	1	0	0	3	20	29	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	61	39	35
21:00	0	0	0	7	16	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	37	37	33
22:00	0	0	0	5	8	5	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	40	34
23:00	0	0	0	3	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	36	32

%	0.2%	0.2%	1.2%	11.2%	40.2%	37.9%	8.1%	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak		08:00	06:00	07:00	08:00	08:00	08:00	08:00						08:00	08:00
Vol.		1	1	9	58	86	26	4						1	183
Midday Peak	12:00	12:00	13:00	12:00	14:00	14:00	12:00	12:00							14:00
Vol.	1	1	4	12	53	79	17	3							154
PM Peak	17:00	17:00	17:00	17:00	17:00	16:00	15:00	15:00							17:00
Vol.	2	2	20	159	240	152	36	4							483
% ile			15th Percentile :			28 MPH									
			50th Percentile :			33 MPH									
			85th Percentile :			38 MPH									
			95th Percentile :			41 MPH									

Stats

10 MPH Pace Speed :	30-39 MPH
Number in Pace :	1941
Percent in Pace :	70.9%
Number of Vehicles > 35 MPH :	1075
Percent of Vehicles > 35 MPH :	39.3%
Mean Speed(Average) :	34 MPH



PRECISION
D A T A
INDUSTRIES, LLC

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Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

123082 D Volume
Site Code: TBA

Old Bedford Road
south of Bedford Street (Route 62)
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

Start Time	13-Nov-12		14-Nov-12		15-Nov-12		16-Nov-12		17-Nov-12		18-Nov-12		19-Nov-12		Week Average	
	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB
12:00 AM	2	2	4	4	2	8	4	10	5	13	11	9	5	4	5	7
01:00	2	0	0	2	0	4	2	3	1	6	4	6	1	3	1	3
02:00	0	0	1	2	1	1	1	1	1	5	0	4	1	0	1	2
03:00	1	0	2	0	0	3	0	1	2	0	3	4	1	1	1	1
04:00	4	6	6	5	6	4	9	8	3	2	1	2	5	1	5	4
05:00	26	6	25	6	20	7	30	8	7	2	2	2	25	7	19	5
06:00	132	31	145	39	153	36	145	35	19	15	8	6	142	30	106	27
07:00	367	131	402	124	393	121	360	122	54	20	29	27	370	121	282	95
08:00	317	190	358	205	359	180	295	180	76	53	62	44	370	183	262	148
09:00	215	104	184	124	187	90	156	101	121	96	62	64	215	97	163	97
10:00	91	93	106	88	101	85	119	100	126	136	103	86	93	96	106	98
11:00	73	131	102	126	94	131	101	126	106	139	102	102	80	115	94	124
12:00 PM	102	111	114	150	136	155	105	160	141	184	129	146	109	145	119	150
01:00	90	107	118	115	111	103	119	143	122	148	139	129	130	140	118	126
02:00	112	137	129	152	103	202	112	187	116	138	121	133	121	154	116	158
03:00	137	287	143	292	158	302	149	329	120	155	105	124	139	286	136	254
04:00	143	443	138	458	133	472	137	436	119	117	90	133	133	425	128	355
05:00	143	486	148	510	173	510	143	392	78	102	54	94	132	483	124	368
06:00	109	243	132	248	140	277	91	239	60	88	58	51	110	228	100	196
07:00	65	101	53	87	64	109	39	66	37	52	46	34	52	86	51	76
08:00	32	63	35	61	34	80	40	42	35	36	25	48	24	61	32	56
09:00	27	49	22	66	27	44	23	44	25	32	12	23	21	37	22	42
10:00	12	29	15	40	15	35	20	49	24	41	15	9	17	23	17	32
11:00	7	8	8	11	9	25	3	19	17	35	2	15	8	11	8	18
Total	2209	2758	2390	2915	2419	2984	2203	2801	1415	1615	1183	1295	2304	2737	2016	2442
Day	4967		5305		5403		5004		3030		2478		5041		4458	
AM Peak	07:00	08:00	07:00	08:00	07:00	08:00	07:00	08:00	10:00	11:00	10:00	11:00	07:00	08:00	07:00	08:00
Vol.	367	190	402	205	393	180	360	180	126	139	103	102	370	183	282	148
PM Peak	16:00	17:00	17:00	17:00	17:00	17:00	15:00	16:00	12:00	12:00	13:00	12:00	15:00	17:00	15:00	17:00
Vol.	143	486	148	510	173	510	149	436	141	184	139	146	139	483	136	368

Comb. Total	4967	5305	5403	5004	3030	2478	5041	4458
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ADT	ADT 4,461	AADT 4,461
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PRECISION
D A T A
INDUSTRIES, LLC

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Old Bedford Road
south of Bedford Street (Route 62)
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 D Volume
Site Code: TBA

Start Time	SB		NB		Combined		13-Nov- 12 Tue
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
12:00	1	26	1	25	2	51	
12:15	0	26	1	27	1	53	
12:30	0	26	0	35	0	61	
12:45	1	24	0	24	1	48	213
01:00	0	25	0	23	0	48	
01:15	0	23	0	30	0	53	
01:30	1	22	0	23	1	45	
01:45	1	20	0	31	1	51	197
02:00	0	34	0	29	0	63	
02:15	0	18	0	35	0	53	
02:30	0	31	0	32	0	63	
02:45	0	29	0	41	0	70	249
03:00	0	31	0	71	0	102	
03:15	0	29	0	60	0	89	
03:30	0	36	0	74	0	110	
03:45	1	41	0	82	1	123	424
04:00	0	39	1	105	1	144	
04:15	1	38	1	89	2	127	
04:30	2	28	1	124	3	152	
04:45	1	38	3	125	4	163	586
05:00	1	40	0	120	1	160	
05:15	6	38	2	142	8	180	
05:30	5	36	0	109	5	145	
05:45	14	29	4	115	18	144	629
06:00	10	29	4	81	14	110	
06:15	24	30	3	62	27	92	
06:30	42	29	8	61	50	90	
06:45	56	21	16	39	72	60	352
07:00	87	22	18	39	105	61	
07:15	82	17	25	21	107	38	
07:30	97	12	40	18	137	30	
07:45	101	14	48	23	149	37	166
08:00	76	9	38	17	114	26	
08:15	86	6	53	19	139	25	
08:30	79	10	43	12	122	22	
08:45	76	7	56	15	132	22	95
09:00	77	8	38	17	115	25	
09:15	65	8	20	13	85	21	
09:30	47	6	16	11	63	17	
09:45	26	5	30	8	56	13	76
10:00	32	2	16	12	48	14	
10:15	25	3	21	4	46	7	
10:30	20	3	18	9	38	12	
10:45	14	4	38	4	52	8	41
11:00	14	2	27	2	41	4	
11:15	11	3	30	3	41	6	
11:30	31	1	36	1	67	2	
11:45	17	1	38	2	55	3	15
Total	1230	979	694	2064	1924	3043	
Percent	63.9%	32.2%	36.1%	67.8%			
Day Total	2209		2758		4967		
Peak	07:00	03:30	08:00	04:30	07:30	04:30	
Vol.	367	154	190	511	539	655	
P.H.F.	0.908	0.939	0.848	0.900	0.904	0.910	



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123082 D Volume
Site Code: TBA

Start Time	SB		NB		Combined		14-Nov- 12 Wed
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
12:00	2	25	2	37	4	62	
12:15	1	24	1	32	2	56	
12:30	0	38	0	47	0	85	
12:45	1	27	1	34	2	61	264
01:00	0	28	0	26	0	54	
01:15	0	29	0	30	0	59	
01:30	0	34	1	31	1	65	
01:45	0	27	1	28	1	55	233
02:00	0	26	0	28	0	54	
02:15	1	29	1	33	2	62	
02:30	0	31	0	39	0	70	
02:45	0	43	1	52	1	95	281
03:00	0	35	0	86	0	121	
03:15	0	43	0	52	0	95	
03:30	0	35	0	68	0	103	
03:45	2	30	0	86	2	116	435
04:00	0	36	1	84	1	120	
04:15	1	31	0	107	1	138	
04:30	2	40	3	127	5	167	
04:45	3	31	1	140	4	171	596
05:00	0	47	0	140	0	187	
05:15	6	35	3	143	9	178	
05:30	9	32	1	129	10	161	
05:45	10	34	2	98	12	132	658
06:00	16	39	7	85	23	124	
06:15	36	33	0	64	36	97	
06:30	27	33	12	52	39	85	
06:45	66	27	20	47	86	74	380
07:00	96	20	26	38	122	58	
07:15	93	17	40	21	133	38	
07:30	99	10	26	10	125	20	
07:45	114	6	32	18	146	24	140
08:00	95	9	37	17	132	26	
08:15	80	10	63	13	143	23	
08:30	93	12	54	20	147	32	
08:45	90	4	51	11	141	15	96
09:00	64	6	38	15	102	21	
09:15	50	8	32	21	82	29	
09:30	41	5	27	15	68	20	
09:45	29	3	27	15	56	18	88
10:00	26	2	29	10	55	12	
10:15	32	3	19	10	51	13	
10:30	24	6	21	9	45	15	
10:45	24	4	19	11	43	15	55
11:00	22	1	26	5	48	6	
11:15	26	2	33	4	59	6	
11:30	24	3	30	2	54	5	
11:45	30	2	37	0	67	2	19
Total	1335	1055	725	2190	2060	3245	
Percent	64.8%	32.5%	35.2%	67.5%			
Day Total	2390		2915		5305		
Peak	07:00	02:45	08:15	04:45	07:45	04:30	
Vol.	402	156	206	552	568	703	
P.H.F.	0.882	0.907	0.817	0.965	0.966	0.940	



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south of Bedford Street (Route 62)
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 D Volume
Site Code: TBA

Start Time	SB		NB		Combined		15-Nov- 12 Thu
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
12:00	1	33	3	37	4	70	
12:15	1	36	0	39	1	75	
12:30	0	32	2	40	2	72	
12:45	0	35	3	39	3	74	291
01:00	0	25	2	26	2	51	
01:15	0	35	0	25	0	60	
01:30	0	23	0	32	0	55	
01:45	0	28	2	20	2	48	214
02:00	1	21	1	37	2	58	
02:15	0	23	0	49	0	72	
02:30	0	35	0	61	0	96	
02:45	0	24	0	55	0	79	305
03:00	0	42	1	100	1	142	
03:15	0	37	0	50	0	87	
03:30	0	48	2	71	2	119	
03:45	0	31	0	81	0	112	460
04:00	1	28	1	102	2	130	
04:15	2	34	1	123	3	157	
04:30	1	25	1	109	2	134	
04:45	2	46	1	138	3	184	605
05:00	1	47	2	127	3	174	
05:15	4	34	1	144	5	178	
05:30	7	48	2	134	9	182	
05:45	8	44	2	105	10	149	683
06:00	14	46	3	99	17	145	
06:15	35	44	6	82	41	126	
06:30	37	24	6	68	43	92	
06:45	67	26	21	28	88	54	417
07:00	86	30	18	26	104	56	
07:15	103	16	30	36	133	52	
07:30	103	11	37	26	140	37	
07:45	101	7	36	21	137	28	173
08:00	77	10	34	23	111	33	
08:15	103	8	61	17	164	25	
08:30	95	7	43	22	138	29	
08:45	84	9	42	18	126	27	114
09:00	77	8	29	14	106	22	
09:15	51	11	14	9	65	20	
09:30	41	3	23	10	64	13	
09:45	18	5	24	11	42	16	71
10:00	25	4	22	2	47	6	
10:15	26	1	17	6	43	7	
10:30	25	7	19	10	44	17	
10:45	25	3	27	17	52	20	50
11:00	22	1	30	12	52	13	
11:15	21	3	37	6	58	9	
11:30	24	3	29	4	53	7	
11:45	27	2	35	3	62	5	34
Total	1316	1103	670	2314	1986	3417	
Percent	66.3%	32.3%	33.7%	67.7%			
Day Total	2419		2984		5403		
Peak	07:00	05:30	08:00	04:45	07:30	04:45	
Vol.	393	182	180	543	552	718	
P.H.F.	0.954	0.948	0.738	0.943	0.841	0.976	



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123082 D Volume
Site Code: TBA

Start		SB		NB		Combined		16-Nov-12 Fri	
Time	A.M.	P.M.		A.M.	P.M.	A.M.	P.M.		
12:00	1	20		4	37	5	57		
12:15	1	29		1	42	2	71		
12:30	2	30		1	42	3	72		
12:45	0	26	105	4	39	4	65	265	
01:00	0	22		2	40	2	62		
01:15	1	33		0	37	1	70		
01:30	0	39		1	26	1	65		
01:45	1	25	119	0	40	1	65	262	
02:00	1	32		1	36	2	68		
02:15	0	30		0	47	0	77		
02:30	0	25		0	42	0	67		
02:45	0	25	112	0	62	0	87	299	
03:00	0	34		1	96	1	130		
03:15	0	41		0	80	0	121		
03:30	0	42		0	82	0	124		
03:45	0	32	149	0	71	0	103	478	
04:00	1	25		3	98	4	123		
04:15	4	32		1	111	5	143		
04:30	2	43		1	114	3	157		
04:45	2	37	137	3	113	5	150	573	
05:00	2	39		1	109	3	148		
05:15	7	34		2	105	9	139		
05:30	6	33		1	99	7	132		
05:45	15	37	143	4	79	19	116	535	
06:00	18	36		3	77	21	113		
06:15	25	30		1	65	26	95		
06:30	43	9		8	55	51	64		
06:45	59	16	91	23	42	82	58	330	
07:00	85	8		17	24	102	32		
07:15	100	11		35	16	135	27		
07:30	73	10		32	16	105	26		
07:45	102	10	39	38	10	140	20	105	
08:00	77	14		34	13	111	27		
08:15	86	11		44	6	130	17		
08:30	71	7		51	15	122	22		
08:45	61	8	40	51	8	112	16	82	
09:00	49	7		32	11	81	18		
09:15	47	5		27	8	74	13		
09:30	31	6		21	16	52	22		
09:45	29	5	23	21	9	50	14	67	
10:00	30	3		19	13	49	16		
10:15	29	3		24	7	53	10		
10:30	33	10		27	15	60	25		
10:45	27	4	20	30	14	57	18	69	
11:00	25	0		23	12	48	12		
11:15	19	2		26	4	45	6		
11:30	26	0		37	2	63	2		
11:45	31	1	3	40	1	71	2	22	
Total	1222	981		695	2106	1917	3087		
Percent	63.7%	31.8%		36.3%	68.2%				
Day Total		2203		2801		5004			
Peak	07:00	04:30		08:00	04:15	07:45	04:15		
Vol.	360	153		180	447	503	598		
P.H.F.	0.882	0.890		0.882	0.980	0.898	0.952		



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123082 D Volume
Site Code: TBA

Start	SB		NB		Combined		17-Nov-12
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	Sat
12:00	1	30	6	66	7	96	
12:15	1	39	1	31	2	70	
12:30	1	33	3	31	4	64	
12:45	2	39	3	56	5	95	325
01:00	1	31	2	38	3	69	
01:15	0	25	3	33	3	58	
01:30	0	29	0	37	0	66	
01:45	0	37	1	40	1	77	270
02:00	0	29	1	25	1	54	
02:15	0	32	2	28	2	60	
02:30	0	28	1	40	1	68	
02:45	1	27	1	45	2	72	254
03:00	0	24	0	41	0	65	
03:15	0	34	0	41	0	75	
03:30	0	34	0	33	0	67	
03:45	2	28	0	40	2	68	275
04:00	1	41	0	26	1	67	
04:15	0	31	1	34	1	65	
04:30	1	17	1	25	2	42	
04:45	1	30	0	32	1	62	236
05:00	0	23	0	31	0	54	
05:15	1	20	0	24	1	44	
05:30	4	20	1	23	5	43	
05:45	2	15	1	24	3	39	180
06:00	3	19	1	27	4	46	
06:15	4	14	2	21	6	35	
06:30	5	12	3	22	8	34	
06:45	7	15	9	18	16	33	148
07:00	9	11	4	15	13	26	
07:15	13	12	2	16	15	28	
07:30	17	5	5	12	22	17	
07:45	15	9	9	9	24	18	89
08:00	18	11	12	14	30	25	
08:15	17	8	10	10	27	18	
08:30	15	7	15	2	30	9	
08:45	26	9	16	53	42	19	71
09:00	22	6	20	10	42	16	
09:15	21	9	27	8	48	17	
09:30	37	5	25	6	62	11	
09:45	41	5	24	96	65	13	57
10:00	33	8	17	8	50	16	
10:15	24	3	32	9	56	12	
10:30	36	10	42	12	78	22	
10:45	33	3	45	136	78	15	65
11:00	24	7	38	15	62	22	
11:15	30	4	37	9	67	13	
11:30	28	2	34	5	62	7	
11:45	24	4	30	139	54	10	52
Total	521	894	487	1128	1008	2022	
Percent	51.7%	44.2%	48.3%	55.8%			
Day Total		1415		1615		3030	
Peak	09:30	00:15	10:30	12:00	10:30	12:00	
Vol.	135	142	162	184	285	325	
P.H.F.	0.823	0.910	0.900	0.697	0.913	0.846	



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
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Email: datarequests@pdillc.com

Old Bedford Road
south of Bedford Street (Route 62)
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 D Volume
Site Code: TBA

Start	SB		NB		Combined		18-Nov-12 Sun	
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.		
12:00	2	29	4	31	6	60		
12:15	2	24	4	42	6	66		
12:30	3	37	1	42	4	79		
12:45	4	39	0	31	4	70	275	
01:00	1	31	3	32	4	63		
01:15	1	40	2	28	3	68		
01:30	1	35	0	35	1	70		
01:45	1	33	1	34	2	67	268	
02:00	0	38	2	36	2	74		
02:15	0	30	0	28	0	58		
02:30	0	27	1	31	1	58		
02:45	0	26	1	38	1	64	254	
03:00	2	25	1	25	3	50		
03:15	0	32	2	34	2	66		
03:30	0	19	0	35	0	54		
03:45	1	29	1	30	2	59	229	
04:00	1	19	0	37	1	56		
04:15	0	28	1	36	1	64		
04:30	0	20	1	36	1	56		
04:45	0	23	0	24	0	47	223	
05:00	0	22	2	25	2	47		
05:15	0	12	0	24	0	36		
05:30	0	14	0	14	0	28		
05:45	2	6	0	31	2	37	148	
06:00	1	21	0	13	1	34		
06:15	2	12	0	15	2	27		
06:30	2	20	0	10	2	30		
06:45	3	5	6	13	9	18	109	
07:00	6	17	5	11	11	28		
07:15	6	11	7	7	13	18		
07:30	9	9	4	12	13	21		
07:45	8	9	11	4	19	13	80	
08:00	10	6	7	15	17	21		
08:15	14	9	8	12	22	21		
08:30	25	4	12	13	37	17		
08:45	13	6	17	8	30	14	73	
09:00	18	4	16	7	34	11		
09:15	13	4	16	7	29	11		
09:30	19	3	18	4	37	7		
09:45	12	1	14	5	26	6	35	
10:00	28	9	22	1	50	10		
10:15	26	5	17	2	43	7		
10:30	25	0	29	4	54	4		
10:45	24	1	18	2	42	3	24	
11:00	17	0	32	8	49	8		
11:15	29	0	20	3	49	3		
11:30	26	2	27	2	53	4		
11:45	30	0	23	2	53	2	17	
Total	387	796	356	939	743	1735		
Percent	52.1%	45.9%	47.9%	54.1%				
Day Total		1183		1295		2478		
Peak	10:00	00:30	11:00	00:15	11:00	00:30		
Vol.	103	147	102	147	204	280		
P.H.F.	0.920	0.919	0.797	0.875	0.962	0.886		



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Old Bedford Road
south of Bedford Street (Route 62)
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 D Volume
Site Code: TBA

Start	SB		NB		Combined		19-Nov-12 Mon	
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.		
12:00	1	30	3	36	4	66		
12:15	1	29	0	36	1	65		
12:30	2	31	1	35	3	66		
12:45	1	19	0	38	1	57	254	
01:00	0	32	1	31	1	63		
01:15	1	32	0	38	1	70		
01:30	0	33	1	34	1	67		
01:45	0	33	1	37	1	70	270	
02:00	0	23	0	26	0	49		
02:15	1	29	0	39	1	68		
02:30	0	30	0	47	0	77		
02:45	0	39	0	42	0	81	275	
03:00	0	35	0	85	0	120		
03:15	0	37	0	60	0	97		
03:30	0	31	1	72	1	103		
03:45	1	36	0	69	1	105	425	
04:00	1	37	0	112	1	149		
04:15	1	32	0	94	1	126		
04:30	1	32	1	113	2	145		
04:45	2	32	0	106	2	138	558	
05:00	2	41	1	150	3	191		
05:15	8	34	3	124	11	158		
05:30	4	28	2	115	6	143		
05:45	11	29	1	94	12	123	615	
06:00	19	45	3	73	22	118		
06:15	23	26	5	67	28	93		
06:30	37	27	7	58	44	85		
06:45	63	12	15	30	78	42	338	
07:00	78	21	19	25	97	46		
07:15	95	14	25	22	120	36		
07:30	101	7	38	24	139	31		
07:45	96	10	39	15	135	25	138	
08:00	97	8	34	19	131	27		
08:15	94	7	45	14	139	21		
08:30	92	5	57	18	149	23		
08:45	87	4	47	10	134	14	85	
09:00	87	9	36	11	123	20		
09:15	47	6	21	10	68	16		
09:30	40	1	15	5	55	6		
09:45	41	5	25	11	66	16	58	
10:00	24	6	17	4	41	10		
10:15	20	4	26	9	46	13		
10:30	25	2	22	7	47	9		
10:45	24	5	31	3	55	8	40	
11:00	25	5	26	7	51	12		
11:15	12	2	27	2	39	4		
11:30	23	0	27	1	50	1		
11:45	20	1	35	1	55	2	19	
Total	1308	996	658	2079	1966	3075		
Percent	66.5%	32.4%	33.5%	67.6%				
Day Total	2304		2737		5041			
Peak	07:15	02:45	08:15	04:45	07:45	04:30		
Vol.	389	142	185	495	554	632		
P.H.F.	0.963	0.910	0.811	0.825	0.930	0.827		



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Bedford Street (Route 62)
west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 E Class
Site Code: TBA

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/13/1														
2	0	1	1	0	0	0	0	0	0	0	0	0	0	2
01:00	0	8	0	0	0	0	0	0	0	0	0	0	0	8
02:00	0	0	0	0	1	0	0	0	0	0	0	0	0	1
03:00	0	1	1	0	0	0	0	0	0	0	0	0	0	2
04:00	1	5	0	1	0	0	0	0	0	0	0	0	0	7
05:00	0	41	8	0	3	0	0	0	0	0	0	0	0	52
06:00	0	122	29	2	4	1	0	1	0	0	0	0	0	159
07:00	0	308	50	5	6	0	0	0	1	0	0	0	0	370
08:00	0	379	58	0	7	2	0	3	0	0	0	0	0	449
09:00	0	266	51	3	5	0	0	1	2	0	0	0	0	328
10:00	0	152	34	0	9	0	1	0	1	0	0	0	0	197
11:00	0	140	40	0	8	0	0	1	1	0	0	0	0	190
12 PM	0	140	35	2	3	1	0	0	0	0	0	0	0	181
13:00	0	130	30	2	11	1	0	0	1	0	0	0	0	175
14:00	0	157	45	0	6	1	0	0	1	0	0	0	0	210
15:00	0	171	57	2	4	1	0	0	0	0	0	0	0	235
16:00	0	186	43	0	9	0	0	0	0	0	0	0	0	238
17:00	1	206	25	1	5	3	0	0	0	0	0	0	0	241
18:00	0	157	23	0	3	0	0	0	0	0	0	0	0	183
19:00	1	92	12	0	1	0	0	0	0	0	0	0	0	106
20:00	0	65	13	0	0	0	0	0	0	0	0	0	0	78
21:00	0	38	6	0	1	0	0	0	0	0	0	0	0	45
22:00	0	29	1	0	2	0	0	0	0	0	0	0	0	32
23:00	0	20	3	0	0	0	0	0	0	0	0	0	0	23
Total	3	2814	565	18	88	10	1	6	7	0	0	0	0	3512
Percent	0.1%	80.1%	16.1%	0.5%	2.5%	0.3%	0.0%	0.2%	0.2%	0.0%	0.0%	0.0%	0.0%	
AM Peak	04:00	08:00	08:00	07:00	10:00	08:00	10:00	08:00	09:00					08:00
Vol.	1	379	58	5	9	2	1	3	2					449
PM Peak	17:00	17:00	15:00	12:00	13:00	17:00			13:00					17:00
Vol.	1	206	57	2	11	3			1					241



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Bedford Street (Route 62)
west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 E Class
Site Code: TBA

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/14/1														
2	0	3	0	0	0	0	0	0	0	0	0	0	0	3
01:00	0	6	0	0	0	0	0	0	0	0	0	0	0	6
02:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
03:00	0	0	0	0	1	0	0	0	0	0	0	0	0	1
04:00	0	4	1	1	0	0	0	0	0	0	0	0	0	6
05:00	2	43	7	1	3	0	0	0	0	0	0	0	0	56
06:00	0	112	31	1	11	0	0	0	0	0	0	0	0	155
07:00	3	341	47	3	8	1	0	1	0	0	0	0	0	404
08:00	1	386	58	2	9	0	0	0	0	0	0	0	0	456
09:00	0	255	46	1	7	0	0	1	0	0	0	0	0	310
10:00	1	128	43	0	6	2	0	1	0	0	0	0	0	181
11:00	0	158	33	2	12	2	0	0	1	0	0	0	0	208
12 PM	1	171	37	3	11	0	0	2	0	0	0	0	0	225
13:00	1	138	40	3	7	0	0	1	1	0	0	0	0	191
14:00	0	153	37	1	4	0	0	0	0	0	0	0	0	195
15:00	2	156	42	3	9	0	1	2	0	0	0	0	0	215
16:00	1	191	43	0	12	2	0	1	0	0	0	0	0	250
17:00	0	212	36	1	2	1	0	0	0	0	0	0	0	252
18:00	1	149	22	0	4	0	0	0	0	0	0	0	0	176
19:00	0	95	12	0	4	0	0	0	0	0	0	0	0	111
20:00	0	67	14	0	2	0	0	0	0	0	0	0	0	83
21:00	0	60	6	0	1	0	0	0	0	0	0	0	0	67
22:00	0	29	4	0	0	0	0	0	0	0	0	0	0	33
23:00	0	19	4	0	0	0	0	0	0	0	0	0	0	23
Total	13	2877	563	22	113	8	1	9	2	0	0	0	0	3608
Percent	0.4%	79.7%	15.6%	0.6%	3.1%	0.2%	0.0%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	
AM Peak	07:00	08:00	08:00	07:00	11:00	10:00		07:00	11:00					08:00
Vol.	3	386	58	3	12	2		1	1					456
PM Peak	15:00	17:00	16:00	12:00	16:00	16:00	15:00	12:00	13:00					17:00
Vol.	2	212	43	3	12	2	1	2	1					252



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Bedford Street (Route 62)
west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 E Class
Site Code: TBA

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/15/1														
2	0	5	1	0	0	0	0	0	0	0	0	0	0	6
01:00	0	7	0	0	0	0	0	0	0	0	0	0	0	7
02:00	0	2	0	0	1	0	0	0	0	0	0	0	0	3
03:00	0	2	0	1	0	0	0	0	0	0	0	0	0	3
04:00	0	7	0	0	0	0	0	0	1	0	0	0	0	8
05:00	0	43	6	1	4	0	0	0	0	0	0	0	0	54
06:00	0	135	35	3	9	1	0	0	0	0	0	0	0	183
07:00	0	341	53	2	9	0	0	0	1	0	0	0	0	406
08:00	1	362	80	3	7	2	0	0	1	0	0	0	0	456
09:00	0	222	48	0	15	1	0	0	3	0	0	0	0	289
10:00	0	167	37	3	8	0	0	1	0	0	0	0	0	216
11:00	0	138	40	0	16	0	0	0	1	0	0	0	0	195
12 PM	1	142	37	3	10	0	0	1	0	0	0	0	0	194
13:00	0	149	35	0	14	0	0	0	1	0	0	0	0	199
14:00	1	146	29	2	5	0	0	0	1	0	0	0	0	184
15:00	0	192	48	2	8	1	0	0	0	0	0	0	0	251
16:00	0	180	40	0	8	1	0	0	0	0	0	0	0	229
17:00	0	223	49	1	5	1	0	0	0	0	0	0	0	279
18:00	0	151	26	0	4	0	0	0	0	0	0	0	0	181
19:00	0	92	15	0	2	0	0	0	0	0	0	0	0	109
20:00	0	72	9	1	1	0	0	0	0	0	0	0	0	83
21:00	0	52	13	0	0	0	0	0	1	0	0	0	0	66
22:00	0	28	8	0	0	1	0	0	0	0	0	0	0	37
23:00	0	27	8	0	0	0	0	0	0	0	0	0	0	35
Total	3	2885	617	22	126	8	0	2	10	0	0	0	0	3673
Percent	0.1%	78.5%	16.8%	0.6%	3.4%	0.2%	0.0%	0.1%	0.3%	0.0%	0.0%	0.0%	0.0%	
AM Peak	08:00	08:00	08:00	06:00	11:00	08:00		10:00	09:00					08:00
Vol.	1	362	80	3	16	2		1	3					456
PM Peak	12:00	17:00	17:00	12:00	13:00	15:00		12:00	13:00					17:00
Vol.	1	223	49	3	14	1		1	1					279



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Bedford Street (Route 62)
west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 E Class
Site Code: TBA

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/16/1														
2	0	11	0	0	0	0	0	0	0	0	0	0	0	11
01:00	0	8	0	0	1	0	0	0	0	0	0	0	0	9
02:00	0	0	1	0	1	0	0	0	0	0	0	0	0	2
03:00	0	1	1	1	0	0	0	0	0	0	0	0	0	3
04:00	0	7	1	0	1	0	0	0	0	0	0	0	0	9
05:00	2	35	4	0	4	0	0	0	0	0	0	0	0	45
06:00	1	116	24	1	8	0	0	3	0	0	0	0	0	153
07:00	1	349	39	2	9	0	0	1	1	0	0	0	0	402
08:00	2	320	51	3	11	0	0	0	0	0	0	0	0	387
09:00	0	204	41	1	8	0	0	3	0	0	0	0	0	257
10:00	0	136	30	0	12	0	0	2	0	0	0	0	0	180
11:00	0	142	36	1	10	1	0	0	0	0	0	0	0	190
12 PM	0	158	34	1	7	2	0	1	0	0	0	0	0	203
13:00	1	150	30	3	7	0	0	0	0	0	0	0	0	191
14:00	0	134	42	1	8	0	0	2	0	0	0	0	0	187
15:00	1	208	46	2	11	2	0	0	0	0	0	0	0	270
16:00	1	198	42	2	7	0	0	1	0	0	0	0	0	251
17:00	0	211	38	0	8	1	0	1	0	0	0	0	0	259
18:00	0	178	18	0	5	1	0	0	0	0	0	0	0	202
19:00	0	109	15	0	2	0	0	0	0	0	0	0	0	126
20:00	0	61	10	0	1	0	0	0	1	0	0	0	0	73
21:00	0	33	9	0	1	0	0	0	0	0	0	0	0	43
22:00	0	53	7	0	1	0	0	1	0	0	0	0	0	62
23:00	0	25	3	0	1	0	0	0	0	0	0	0	0	29
Total	9	2847	522	18	124	7	0	15	2	0	0	0	0	3544
Percent	0.3%	80.3%	14.7%	0.5%	3.5%	0.2%	0.0%	0.4%	0.1%	0.0%	0.0%	0.0%	0.0%	
AM Peak	05:00	07:00	08:00	08:00	10:00	11:00		06:00	07:00					07:00
Vol.	2	349	51	3	12	1		3	1					402
PM Peak	13:00	17:00	15:00	13:00	15:00	12:00		14:00	20:00					15:00
Vol.	1	211	46	3	11	2		2	1					270



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123082 E Class
Site Code: TBA

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/17/1														
2	0	13	3	0	0	0	0	0	0	0	0	0	0	16
01:00	0	6	1	0	0	0	0	0	0	0	0	0	0	7
02:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
03:00	0	3	1	1	1	0	0	0	0	0	0	0	0	6
04:00	0	4	0	0	0	0	0	0	0	0	0	0	0	4
05:00	0	16	1	1	2	0	0	0	0	0	0	0	0	20
06:00	0	25	7	0	2	0	0	0	0	0	0	0	0	34
07:00	0	48	19	0	8	0	0	1	0	0	0	0	0	76
08:00	0	98	25	0	9	1	0	0	0	0	0	0	0	133
09:00	0	119	29	0	9	0	0	0	0	0	0	0	0	157
10:00	3	179	29	0	7	1	0	1	0	0	0	0	0	220
11:00	4	150	36	1	12	1	0	0	0	0	0	0	0	204
12 PM	8	204	32	0	4	0	0	0	0	0	0	0	0	248
13:00	5	190	29	0	6	1	0	0	0	0	0	0	0	231
14:00	7	215	40	2	9	0	0	1	0	0	0	0	0	274
15:00	7	163	30	0	10	0	0	0	0	0	0	0	0	210
16:00	3	126	27	0	2	0	0	0	0	0	0	0	0	158
17:00	0	140	27	0	5	1	0	0	0	0	0	0	0	173
18:00	0	119	15	1	2	0	0	0	0	0	0	0	0	137
19:00	0	65	10	0	0	0	0	0	0	0	0	0	0	75
20:00	0	50	9	0	0	0	0	0	0	0	0	0	0	59
21:00	0	57	7	0	1	0	0	0	0	0	0	0	0	65
22:00	0	57	7	0	1	0	0	0	0	0	0	0	0	65
23:00	0	40	2	0	0	0	0	0	0	0	0	0	0	42
Total	37	2089	386	6	90	5	0	3	0	0	0	0	0	2616
Percent	1.4%	79.9%	14.8%	0.2%	3.4%	0.2%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	11:00	10:00	11:00	03:00	11:00	08:00		07:00						10:00
Vol.	4	179	36	1	12	1		1						220
PM Peak	12:00	14:00	14:00	14:00	15:00	13:00		14:00						14:00
Vol.	8	215	40	2	10	1		1						274



PRECISION
D A T A
INDUSTRIES, LLC

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Bedford Street (Route 62)
west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 E Class
Site Code: TBA

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/18/1														
2	0	18	1	0	0	0	0	0	0	0	0	0	0	19
01:00	0	2	3	0	2	0	0	0	0	0	0	0	0	7
02:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
03:00	0	3	0	0	0	0	0	0	0	0	0	0	0	3
04:00	0	2	0	0	1	0	0	0	0	0	0	0	0	3
05:00	0	14	2	0	0	0	0	0	0	0	0	0	0	16
06:00	1	17	4	0	2	0	0	0	0	0	0	0	0	24
07:00	0	48	9	0	1	0	0	0	0	0	0	0	0	58
08:00	0	69	11	0	3	0	0	0	0	0	0	0	0	83
09:00	1	78	21	0	3	0	0	0	0	0	0	0	0	103
10:00	3	112	27	0	4	0	0	0	0	0	0	0	0	146
11:00	4	121	17	0	1	4	0	0	0	0	0	0	0	147
12 PM	2	191	24	0	0	0	0	0	0	0	0	0	0	217
13:00	5	190	24	0	2	0	0	0	0	0	0	0	0	221
14:00	5	148	22	0	0	0	0	1	0	0	0	0	0	176
15:00	4	187	19	1	3	0	0	1	0	0	0	0	0	215
16:00	1	140	21	0	4	0	0	0	0	0	0	0	0	166
17:00	0	93	12	0	3	0	0	0	0	0	0	0	0	108
18:00	0	85	12	0	1	0	0	0	0	0	0	0	0	98
19:00	0	63	11	0	4	0	0	0	0	0	0	0	0	78
20:00	0	49	10	0	4	0	0	0	0	0	0	0	0	63
21:00	0	32	9	0	0	0	0	0	0	0	0	0	0	41
22:00	0	20	2	0	1	0	0	0	0	0	0	0	0	23
23:00	0	25	2	0	0	0	0	0	0	0	0	0	0	27
Total	26	1708	263	1	39	4	0	2	0	0	0	0	0	2043
Percent	1.3%	83.6%	12.9%	0.0%	1.9%	0.2%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	11:00	11:00	10:00		10:00	11:00								11:00
Vol.	4	121	27		4	4								147
PM Peak	13:00	12:00	12:00	15:00	16:00			14:00						13:00
Vol.	5	191	24	1	4			1						221



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123082 E Class
Site Code: TBA

Bedford Street (Route 62)
west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

EB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/19/1														
2	0	9	0	0	0	0	0	0	0	0	0	0	0	9
01:00	0	4	3	0	0	0	0	0	0	0	0	0	0	7
02:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
03:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
04:00	0	11	0	0	1	0	0	0	0	0	0	0	0	12
05:00	0	33	7	1	4	0	0	0	0	0	0	0	0	45
06:00	1	125	26	2	8	1	0	1	0	0	0	0	0	164
07:00	2	319	46	4	19	0	0	2	0	0	0	0	0	392
08:00	1	387	66	3	11	0	0	1	1	0	0	0	0	470
09:00	0	224	47	1	8	0	0	2	0	0	0	0	0	282
10:00	0	123	39	2	5	2	0	1	0	0	0	0	0	172
11:00	0	126	42	0	8	0	0	1	0	0	0	0	0	177
12 PM	1	126	37	1	9	2	0	1	0	0	0	0	0	177
13:00	1	146	33	0	5	1	0	1	0	0	0	0	0	187
14:00	0	143	41	1	14	0	0	1	0	0	0	0	0	200
15:00	0	174	32	2	10	2	0	3	1	0	0	0	0	224
16:00	1	188	43	1	14	0	0	2	2	0	0	0	0	251
17:00	1	198	31	0	4	1	0	1	0	0	0	0	0	236
18:00	1	142	32	0	3	0	0	0	0	0	0	0	0	178
19:00	1	94	19	0	2	0	0	0	0	0	0	0	0	116
20:00	0	49	4	0	1	0	0	0	0	0	0	0	0	54
21:00	0	55	11	0	0	0	0	0	0	0	0	0	0	66
22:00	0	39	5	0	1	0	0	0	0	0	0	0	0	45
23:00	0	17	5	0	0	0	0	0	0	0	0	0	0	22
Total	10	2735	569	18	127	9	0	17	4	0	0	0	0	3489
Percent	0.3%	78.4%	16.3%	0.5%	3.6%	0.3%	0.0%	0.5%	0.1%	0.0%	0.0%	0.0%	0.0%	
AM Peak	07:00	08:00	08:00	07:00	07:00	10:00		07:00	08:00					08:00
Vol.	2	387	66	4	19	2		2	1					470
PM Peak	12:00	17:00	16:00	15:00	14:00	12:00		15:00	16:00					16:00
Vol.	1	198	43	2	14	2		3	2					251
Total		17955	3485	105	707	51	2	54	25	0	0	0	0	22485



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Bedford Street (Route 62)
west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 E Class
Site Code: TBA

WB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/13/1														
2	0	4	2	0	0	0	0	0	0	0	0	0	0	6
01:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
02:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
03:00	0	3	0	1	0	0	0	0	0	0	0	0	0	4
04:00	0	2	3	0	0	1	0	0	0	0	0	0	0	6
05:00	0	26	6	1	0	1	0	0	0	0	0	0	0	34
06:00	0	91	22	1	3	1	0	0	0	0	0	0	0	118
07:00	1	188	47	2	8	0	0	1	0	0	0	0	0	247
08:00	0	215	47	3	3	0	0	0	1	0	0	0	0	269
09:00	1	181	38	1	4	2	0	1	2	0	0	0	0	230
10:00	1	159	44	0	9	0	0	0	1	0	0	0	0	214
11:00	0	152	39	0	5	1	0	0	1	0	0	0	0	198
12 PM	0	138	40	1	2	0	0	0	0	0	0	0	0	181
13:00	0	167	40	0	5	0	0	0	1	0	0	0	0	213
14:00	0	206	48	1	6	0	0	0	0	0	0	0	0	261
15:00	1	265	62	1	3	1	0	2	0	0	0	0	0	335
16:00	0	431	70	0	3	1	0	1	0	0	0	0	0	506
17:00	3	556	59	1	3	0	0	0	0	0	0	0	0	622
18:00	1	399	51	0	5	0	0	1	0	0	0	0	0	457
19:00	0	179	26	0	1	0	0	0	0	0	0	0	0	206
20:00	0	107	6	0	0	0	0	0	0	0	0	0	0	113
21:00	0	63	5	0	0	0	0	0	0	0	0	0	0	68
22:00	0	29	0	0	0	0	0	0	0	0	0	0	0	29
23:00	0	14	3	0	0	0	0	0	0	0	0	0	0	17
Total	8	3578	658	13	60	8	0	6	6	0	0	0	0	4337
Percent	0.2%	82.5%	15.2%	0.3%	1.4%	0.2%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	
AM Peak	07:00	08:00	07:00	08:00	10:00	09:00		07:00	09:00					08:00
Vol.	1	215	47	3	9	2		1	2					269
PM Peak	17:00	17:00	16:00	12:00	14:00	15:00		15:00	13:00					17:00
Vol.	3	556	70	1	6	1		2	1					622



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Bedford Street (Route 62)
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123082 E Class
Site Code: TBA

WB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/14/1														
2	0	11	0	0	0	0	0	0	0	0	0	0	0	11
01:00	0	3	0	0	1	0	0	0	0	0	0	0	0	4
02:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
03:00	0	5	0	1	0	0	0	0	0	0	0	0	0	6
04:00	0	4	3	0	0	0	0	0	0	0	0	0	0	7
05:00	0	29	7	0	1	0	0	0	0	0	0	0	0	37
06:00	0	98	13	0	1	0	0	0	0	0	0	0	0	112
07:00	0	163	37	3	4	2	0	0	0	0	0	0	0	209
08:00	2	240	55	3	5	1	0	1	1	0	0	0	0	308
09:00	1	178	32	0	5	1	0	1	1	0	0	0	0	219
10:00	0	138	29	1	10	3	0	2	1	0	0	0	0	184
11:00	0	171	32	2	4	0	0	0	2	0	0	0	0	211
12 PM	0	174	43	1	9	1	0	0	0	0	0	0	0	228
13:00	1	194	26	3	5	0	0	0	0	0	0	0	0	229
14:00	0	206	37	2	8	1	0	4	0	0	0	0	0	258
15:00	0	277	65	0	4	3	0	1	0	0	0	0	0	350
16:00	0	433	58	1	3	2	0	0	0	0	0	0	0	497
17:00	2	539	51	1	0	0	0	1	0	0	0	0	0	594
18:00	0	357	31	0	2	0	0	0	0	0	0	0	0	390
19:00	0	190	28	0	0	0	0	0	0	0	0	0	0	218
20:00	0	101	13	0	2	0	0	0	0	0	0	0	0	116
21:00	1	64	8	0	0	0	0	0	0	0	0	0	0	73
22:00	0	34	2	0	0	0	0	0	0	0	0	0	0	36
23:00	0	24	1	0	0	0	0	0	0	0	0	0	0	25
Total	7	3634	571	18	64	14	0	10	5	0	0	0	0	4323
Percent	0.2%	84.1%	13.2%	0.4%	1.5%	0.3%	0.0%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	
AM Peak	08:00	08:00	08:00	07:00	10:00	10:00		10:00	11:00					08:00
Vol.	2	240	55	3	10	3		2	2					308
PM Peak	17:00	17:00	15:00	13:00	12:00	15:00		14:00						17:00
Vol.	2	539	65	3	9	3		4						594



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123082 E Class
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WB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/15/1														
2	0	6	1	0	0	0	0	0	0	0	0	0	0	7
01:00	0	3	0	0	0	0	0	0	0	0	0	0	0	3
02:00	0	4	0	0	0	0	0	0	0	0	0	0	0	4
03:00	0	4	2	1	0	0	0	0	0	0	0	0	0	7
04:00	0	1	0	0	1	0	0	0	0	0	0	0	0	2
05:00	0	14	14	0	0	0	0	0	0	0	0	0	0	28
06:00	0	93	19	2	5	3	0	0	0	0	0	0	0	122
07:00	0	184	45	2	10	0	0	0	1	0	0	0	0	242
08:00	1	180	63	1	7	1	0	0	0	0	0	0	0	253
09:00	0	168	53	1	3	1	0	1	2	0	0	0	0	229
10:00	0	135	45	2	4	0	0	0	1	0	0	0	0	187
11:00	0	153	39	4	7	0	0	0	1	0	0	0	0	204
12 PM	0	169	32	1	8	0	0	0	0	0	0	0	0	210
13:00	0	181	31	2	6	0	0	0	1	0	0	0	0	221
14:00	0	238	38	1	6	0	0	0	0	0	0	0	0	283
15:00	1	281	62	1	3	2	0	1	0	0	0	0	0	351
16:00	1	450	72	0	4	1	0	1	0	0	0	0	0	529
17:00	3	508	53	1	5	1	0	0	0	0	0	0	0	571
18:00	2	387	51	0	0	1	0	1	0	0	0	0	0	442
19:00	0	172	17	1	1	0	0	0	0	0	0	0	0	191
20:00	0	111	16	0	0	0	0	0	0	0	0	0	0	127
21:00	0	86	10	0	2	0	0	0	1	0	0	0	0	99
22:00	0	39	2	0	0	0	0	0	0	0	0	0	0	41
23:00	0	18	3	0	0	0	0	0	0	0	0	0	0	21
Total	8	3585	668	20	72	10	0	4	7	0	0	0	0	4374
Percent	0.2%	82.0%	15.3%	0.5%	1.6%	0.2%	0.0%	0.1%	0.2%	0.0%	0.0%	0.0%	0.0%	
AM Peak	08:00	07:00	08:00	11:00	07:00	06:00		09:00	09:00					08:00
Vol.	1	184	63	4	10	3		1	2					253
PM Peak	17:00	17:00	16:00	13:00	12:00	15:00		15:00	13:00					17:00
Vol.	3	508	72	2	8	2		1	1					571



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123082 E Class
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WB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/16/1														
2	0	12	1	0	0	0	0	0	0	0	0	0	0	13
01:00	0	2	1	0	0	0	0	0	0	0	0	0	0	3
02:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
03:00	0	5	0	1	0	0	0	0	0	0	0	0	0	6
04:00	0	0	1	0	1	0	0	0	0	0	0	0	0	2
05:00	0	22	7	0	2	1	0	0	0	0	0	0	0	32
06:00	1	96	18	1	2	0	0	0	0	0	0	0	0	118
07:00	1	167	37	0	8	3	0	0	0	0	0	0	0	216
08:00	1	202	52	4	5	2	0	0	0	0	0	0	0	266
09:00	1	141	38	0	4	3	0	1	0	0	0	0	0	188
10:00	0	141	38	3	2	1	0	1	0	0	0	0	0	186
11:00	0	174	33	1	5	3	0	1	0	0	0	0	0	217
12 PM	0	189	41	1	8	2	0	0	0	0	0	0	0	241
13:00	1	190	31	1	5	0	0	1	0	0	0	0	0	229
14:00	0	212	47	2	7	1	0	0	0	0	0	0	0	269
15:00	3	310	63	0	5	0	0	0	0	0	0	0	0	381
16:00	0	396	57	0	5	1	0	4	0	0	0	0	0	463
17:00	1	468	60	0	2	1	0	0	0	0	0	0	0	532
18:00	2	275	33	0	2	0	0	1	0	0	0	0	0	313
19:00	0	147	11	0	1	0	0	0	0	0	0	0	0	159
20:00	0	91	13	0	1	0	0	0	0	0	0	0	0	105
21:00	0	66	5	0	0	0	0	0	0	0	0	0	0	71
22:00	0	65	4	0	1	0	0	0	0	0	0	0	0	70
23:00	0	25	4	0	1	0	0	0	0	0	0	0	0	30
Total	11	3398	595	14	67	18	0	9	0	0	0	0	0	4112
Percent	0.3%	82.6%	14.5%	0.3%	1.6%	0.4%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	06:00	08:00	08:00	08:00	07:00	07:00		09:00						08:00
Vol.	1	202	52	4	8	3		1						266
PM Peak	15:00	17:00	15:00	14:00	12:00	12:00		16:00						17:00
Vol.	3	468	63	2	8	2		4						532



PRECISION
D A T A
INDUSTRIES, LLC

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Email: datarequests@pdillc.com

Bedford Street (Route 62)
west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 E Class
Site Code: TBA

WB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/17/1														
2	0	22	1	0	1	0	0	0	0	0	0	0	0	24
01:00	0	5	0	0	0	0	0	0	0	0	0	0	0	5
02:00	0	5	2	0	0	0	0	0	0	0	0	0	0	7
03:00	0	2	0	1	0	0	0	0	0	0	0	0	0	3
04:00	0	5	1	0	2	0	0	0	0	0	0	0	0	8
05:00	0	7	1	0	0	0	0	0	0	0	0	0	0	8
06:00	0	42	7	0	1	0	0	1	0	0	0	0	0	51
07:00	0	62	17	0	2	0	0	0	0	0	0	0	0	81
08:00	0	89	26	0	8	0	0	0	1	0	0	0	0	124
09:00	0	147	34	0	5	1	0	0	0	0	0	0	0	187
10:00	0	168	29	0	3	0	0	1	0	0	0	0	0	201
11:00	3	205	42	1	7	1	0	1	0	0	0	0	0	260
12 PM	3	197	29	1	0	2	0	1	1	0	0	0	0	234
13:00	1	211	23	0	4	0	0	1	0	0	0	0	0	240
14:00	4	209	31	0	2	0	0	0	0	0	0	0	0	246
15:00	1	286	39	3	9	2	0	0	0	0	0	0	0	340
16:00	2	244	33	0	2	0	0	0	0	0	0	0	0	281
17:00	0	149	12	1	2	0	0	1	0	0	0	0	0	165
18:00	0	140	21	1	0	0	0	0	0	0	0	0	0	162
19:00	1	95	17	0	0	0	0	1	0	0	0	0	0	114
20:00	0	92	14	0	3	0	0	0	0	0	0	0	0	109
21:00	0	66	7	0	1	0	0	0	0	0	0	0	0	74
22:00	0	55	3	0	0	0	0	0	0	0	0	0	0	58
23:00	0	34	2	0	0	0	0	0	0	0	0	0	0	36
Total	15	2537	391	8	52	6	0	7	2	0	0	0	0	3018
Percent	0.5%	84.1%	13.0%	0.3%	1.7%	0.2%	0.0%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	
AM Peak	11:00	11:00	11:00	03:00	08:00	09:00		06:00	08:00					11:00
Vol.	3	205	42	1	8	1		1	1					260
PM Peak	14:00	15:00	15:00	15:00	15:00	12:00		12:00	12:00					15:00
Vol.	4	286	39	3	9	2		1	1					340



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123082 E Class
Site Code: TBA

WB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/18/1														
2	0	15	0	0	1	0	0	0	0	0	0	0	0	16
01:00	0	10	0	0	0	0	0	0	0	0	0	0	0	10
02:00	0	3	0	0	0	0	0	0	0	0	0	0	0	3
03:00	0	5	0	0	0	0	0	0	0	0	0	0	0	5
04:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
05:00	0	4	0	0	0	0	0	0	0	0	0	0	0	4
06:00	0	19	7	0	0	0	0	0	0	0	0	0	0	26
07:00	0	43	11	0	1	1	0	0	0	0	0	0	0	56
08:00	1	76	10	0	0	0	0	0	0	0	0	0	0	87
09:00	0	113	20	0	0	0	0	0	0	0	0	0	0	133
10:00	1	111	19	0	1	0	0	0	0	0	0	0	0	132
11:00	0	178	19	0	2	0	0	1	0	0	0	0	0	200
12 PM	0	170	26	0	0	0	0	0	0	0	0	0	0	196
13:00	3	186	24	0	0	1	0	0	0	0	0	0	0	214
14:00	2	221	23	0	2	0	0	0	0	0	0	0	0	248
15:00	1	220	23	0	2	0	0	1	0	0	0	0	0	247
16:00	0	188	27	0	2	0	0	0	0	0	0	0	0	217
17:00	0	112	16	0	1	0	0	1	0	0	0	0	0	130
18:00	0	115	21	0	1	0	0	0	0	0	0	0	0	137
19:00	0	76	13	0	3	0	0	0	0	0	0	0	0	92
20:00	0	85	7	0	0	0	0	0	0	0	0	0	0	92
21:00	0	45	3	0	0	0	0	0	0	0	0	0	0	48
22:00	0	17	1	0	0	0	0	0	0	0	0	0	0	18
23:00	0	15	0	0	0	0	0	0	0	0	0	0	0	15
Total	8	2029	270	0	16	2	0	3	0	0	0	0	0	2328
Percent	0.3%	87.2%	11.6%	0.0%	0.7%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	08:00	11:00	09:00		11:00	07:00		11:00						11:00
Vol.	1	178	20		2	1		1						200
PM Peak	13:00	14:00	16:00		19:00	13:00		15:00						14:00
Vol.	3	221	27		3	1		1						248



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123082 E Class
Site Code: TBA

WB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
11/19/1														
2	0	12	0	0	0	0	0	0	0	0	0	0	0	12
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	2	0	0	0	1	0	0	0	0	0	0	0	3
03:00	0	1	1	1	0	0	0	0	0	0	0	0	0	3
04:00	0	8	4	0	1	0	0	0	0	0	0	0	0	13
05:00	0	18	7	0	1	0	0	0	0	0	0	0	0	26
06:00	0	88	17	0	3	3	0	0	0	0	0	0	0	111
07:00	0	164	40	2	4	1	0	0	0	0	0	0	0	211
08:00	0	198	55	2	7	1	0	2	1	0	0	0	0	266
09:00	1	171	49	1	6	0	0	2	0	0	0	0	0	230
10:00	0	139	44	2	6	2	0	0	0	0	0	0	0	193
11:00	0	156	27	1	7	3	0	1	0	0	0	0	0	195
12 PM	1	164	54	0	10	2	0	4	0	0	0	0	0	235
13:00	0	174	35	0	4	1	0	2	0	0	0	0	0	216
14:00	2	229	47	0	7	0	0	0	0	0	0	0	0	285
15:00	1	292	81	1	7	0	0	1	1	0	0	0	0	384
16:00	1	419	61	0	2	2	0	1	0	0	0	0	0	486
17:00	2	530	63	1	5	0	0	1	0	0	0	0	0	602
18:00	0	352	39	0	5	1	0	1	1	0	0	0	0	399
19:00	0	193	24	0	0	0	0	0	0	0	0	0	0	217
20:00	0	95	12	0	0	1	0	0	0	0	0	0	0	108
21:00	0	52	11	0	0	0	0	0	0	0	0	0	0	63
22:00	0	36	3	0	0	0	0	0	0	0	0	0	0	39
23:00	0	19	0	0	0	0	0	0	0	0	0	0	0	19
Total	8	3512	674	11	75	18	0	15	3	0	0	0	0	4316
Percent	0.2%	81.4%	15.6%	0.3%	1.7%	0.4%	0.0%	0.3%	0.1%	0.0%	0.0%	0.0%	0.0%	
AM Peak	09:00	08:00	08:00	07:00	08:00	06:00		08:00	08:00					08:00
Vol.	1	198	55	2	7	3		2	1					266
PM Peak	14:00	17:00	15:00	15:00	12:00	12:00		12:00	15:00					17:00
Vol.	2	530	81	1	10	2		4	1					602
Total		22273	3827	84	406	76	0	54	23	0	0	0	0	26808



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123082 E Speed
Site Code: TBA

EB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
11/13/1																												
2	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	*	37
01:00	0	0	0	0	0	1	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	42	39
02:00	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	*	42
03:00	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	*	44
04:00	0	0	0	1	0	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	38	38
05:00	0	0	0	0	5	28	16	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	52	42	39
06:00	0	0	2	3	43	86	19	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	159	39	36
07:00	16	2	7	11	71	194	63	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	371	40	34
08:00	7	30	20	15	79	206	86	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	450	40	33
09:00	0	1	4	8	68	168	71	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	328	41	37
10:00	0	0	2	9	39	95	48	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	197	41	37
11:00	1	3	2	8	34	85	52	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	190	41	36
12 PM	0	0	4	6	38	92	38	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	181	40	37
13:00	0	0	3	13	35	93	24	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	175	40	36
14:00	5	3	5	11	43	105	34	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	210	40	35
15:00	0	0	1	7	66	112	42	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	235	40	36
16:00	0	2	4	12	91	108	19	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	238	38	35
17:00	6	5	8	12	85	109	15	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	241	38	33
18:00	1	2	2	3	67	87	18	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	183	39	35
19:00	0	1	2	13	30	45	12	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	106	39	35
20:00	0	0	1	2	16	41	14	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	78	41	37
21:00	0	0	0	4	9	19	10	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	41	37
22:00	0	0	0	3	9	16	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32	39	35
23:00	0	0	0	0	3	7	7	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	47	41

%	1.0%	1.4%	1.9%	4.0%	23.7%	48.4%	17.1%	2.3%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AM Peak	07:00	08:00	08:00	08:00	08:00	08:00	08:00	09:00	07:00	05:00																08:00		
Vol.	16	30	20	15	79	206	86	8	1	1																450		
Midday Peak	14:00	11:00	14:00	13:00	14:00	14:00	11:00	13:00	12:00																	14:00		
Vol.	5	3	5	13	43	105	52	6	1																	210		
PM Peak	17:00	17:00	17:00	19:00	16:00	15:00	15:00	15:00	23:00																	17:00		
Vol.	6	5	8	13	91	112	42	7	2																	241		
% ile				15th Percentile :		29 MPH																						
				50th Percentile :		35 MPH																						
				85th Percentile :		40 MPH																						
				95th Percentile :		43 MPH																						

Stats	10 MPH Pace Speed :	32-41 MPH
	Number in Pace :	2407
	Percent in Pace :	68.5%
	Number of Vehicles > 35 MPH :	1985
	Percent of Vehicles > 35 MPH :	56.5%
	Mean Speed(Average) :	35 MPH



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Site Code: TBA

EB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/14/1																
2	0	0	0	0	0	1	2	0	0	0	0	0	0	3	*	40
01:00	0	0	0	0	0	0	6	0	0	0	0	0	0	6	43	42
02:00	0	0	0	0	1	0	0	0	0	0	0	0	0	1	*	32
03:00	0	0	0	0	0	1	0	0	0	0	0	0	0	1	*	37
04:00	0	0	0	0	1	2	0	3	0	0	0	0	0	6	46	41
05:00	0	0	0	0	4	24	22	5	0	1	0	0	0	56	43	40
06:00	0	0	0	6	22	89	33	5	0	0	0	0	0	155	41	37
07:00	9	10	20	11	46	211	86	11	0	0	0	0	0	404	40	35
08:00	0	3	11	37	75	203	119	8	0	0	0	0	0	456	41	36
09:00	2	3	6	15	35	159	86	4	0	0	0	0	0	310	41	37
10:00	0	1	4	6	36	97	32	4	1	0	0	0	0	181	40	36
11:00	1	7	6	11	35	98	47	3	0	0	0	0	0	208	40	35
12 PM	0	0	1	10	45	91	69	8	1	0	0	0	0	225	42	37
13:00	0	2	3	5	46	84	45	5	1	0	0	0	0	191	41	36
14:00	3	0	5	11	42	84	46	4	1	0	0	0	0	196	41	36
15:00	7	8	13	34	56	74	21	2	0	0	0	0	0	215	38	31
16:00	0	1	3	7	67	118	46	7	1	0	0	0	0	250	40	36
17:00	1	4	3	14	71	140	17	2	0	0	0	0	0	252	38	35
18:00	1	3	2	8	49	89	20	3	0	1	0	0	0	176	39	35
19:00	0	0	3	8	27	53	20	0	0	0	0	0	0	111	40	36
20:00	0	1	0	1	15	45	20	1	0	0	0	0	0	83	41	37
21:00	0	0	0	1	16	30	17	3	0	0	0	0	0	67	41	37
22:00	0	0	0	1	3	17	9	2	1	0	0	0	0	33	42	39
23:00	0	0	0	1	3	11	4	3	1	0	0	0	0	23	44	39

%	0.7%	1.2%	2.2%	5.2%	19.3%	47.7%	21.3%	2.3%	0.2%	0.1%	0.0%	0.0%	0.0%															
AM Peak Vol.	07:00	07:00	07:00	08:00	08:00	07:00	08:00	07:00		05:00																08:00		
	9	10	20	37	75	211	119	11		1																456		
Midday Peak Vol.	14:00	11:00	11:00	11:00	13:00	11:00	12:00	12:00	12:00																	12:00		
	3	7	6	11	46	98	69	8	1																	225		
PM Peak Vol.	15:00	15:00	15:00	15:00	17:00	17:00	16:00	16:00	16:00	18:00																17:00		
	7	8	13	34	71	140	46	7	1	1																252		
% ile				15th Percentile :		30 MPH																						
				50th Percentile :		36 MPH																						
				85th Percentile :		41 MPH																						
				95th Percentile :		43 MPH																						

Stats

10 MPH Pace Speed : 33-42 MPH

Number in Pace : 2433

Percent in Pace : 67.4%

Number of Vehicles > 35 MPH : 2172

Percent of Vehicles > 35 MPH : 60.2%

Mean Speed(Average) : 36 MPH



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123082 E Speed
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EB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/15/1																
2	0	0	0	0	1	1	3	1	0	0	0	0	0	6	42	40
01:00	0	0	0	0	0	3	2	1	1	0	0	0	0	7	38	42
02:00	0	0	0	0	0	0	0	2	1	0	0	0	0	3	*	49
03:00	0	0	0	0	2	0	0	1	0	0	0	0	0	3	*	37
04:00	0	0	0	0	2	2	1	3	0	0	0	0	0	8	46	40
05:00	0	0	0	0	2	27	24	1	0	0	0	0	0	54	42	39
06:00	0	0	1	6	39	97	36	3	0	1	0	0	0	183	40	37
07:00	3	1	2	30	90	179	94	7	0	0	0	0	0	406	41	36
08:00	2	0	6	22	112	225	85	4	0	0	0	0	0	456	40	36
09:00	1	3	9	6	79	146	44	1	0	0	0	0	0	289	39	35
10:00	0	1	6	7	22	133	44	3	0	0	0	0	0	216	40	37
11:00	0	5	4	9	36	89	49	2	1	0	0	0	0	195	41	36
12 PM	0	2	2	5	26	95	54	8	2	0	0	0	0	194	42	38
13:00	0	0	5	11	54	85	43	1	0	0	0	0	0	199	40	36
14:00	1	3	6	9	38	95	28	4	0	0	0	0	0	184	40	35
15:00	2	4	16	24	34	136	30	5	0	0	0	0	0	251	39	34
16:00	0	0	2	7	62	109	47	2	0	0	0	0	0	229	40	36
17:00	2	6	10	7	85	136	33	0	0	0	0	0	0	279	39	34
18:00	0	1	3	13	26	112	22	3	1	0	0	0	0	181	39	36
19:00	0	0	1	5	16	63	20	4	0	0	0	0	0	109	40	37
20:00	0	0	1	4	16	48	11	2	0	0	0	0	1	83	39	36
21:00	0	0	0	3	21	29	11	2	0	0	0	0	0	66	40	36
22:00	0	0	0	1	7	20	8	1	0	0	0	0	0	37	40	37
23:00	0	0	0	1	3	17	6	7	1	0	0	0	0	35	45	40

%	0.3%	0.7%	2.0%	4.6%	21.0%	50.3%	18.9%	1.9%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AM Peak Vol.	07:00	09:00	09:00	07:00	08:00	08:00	07:00	07:00	01:00	06:00																08:00	
	3	3	9	30	112	225	94	7	1	1																456	
Midday Peak Vol.	14:00	11:00	14:00	13:00	13:00	12:00	12:00	12:00	12:00																	13:00	
	1	5	6	11	54	95	54	8	2																	199	
PM Peak Vol.	15:00	17:00	15:00	15:00	17:00	15:00	16:00	23:00	18:00																	17:00	
	2	6	16	24	85	136	47	7	1																	279	
% ile				15th Percentile :		30 MPH																					
				50th Percentile :		36 MPH																					
				85th Percentile :		40 MPH																					
				95th Percentile :		43 MPH																					

Stats

10 MPH Pace Speed : 32-41 MPH

Number in Pace : 2575

Percent in Pace : 70.1%

Number of Vehicles > 35 MPH : 2194

Percent of Vehicles > 35 MPH : 59.7%

Mean Speed(Average) : 36 MPH



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

123082 E Speed
Site Code: TBA

Bedford Street (Route 62)
west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

EB

Start Time	14	15	20	25	30	35	40	45	50	55	60	65	70	Total	85th % ile	Ave Speed
11/16/1																
2	0	0	0	0	2	2	5	2	0	0	0	0	0	11	44	40
01:00	0	0	0	0	3	3	3	0	0	0	0	0	0	9	40	37
02:00	0	0	0	0	0	1	1	0	0	0	0	0	0	2	*	39
03:00	0	0	0	0	0	3	0	0	0	0	0	0	0	3	36	37
04:00	0	0	0	2	0	3	1	2	1	0	0	0	0	9	37	39
05:00	0	0	0	2	1	11	26	4	0	1	0	0	0	45	44	41
06:00	2	1	0	2	32	86	28	2	0	0	0	0	0	153	40	36
07:00	4	15	9	5	70	231	61	7	0	0	0	0	0	402	40	35
08:00	0	2	2	36	83	196	66	3	0	0	0	0	0	388	40	36
09:00	4	2	4	9	57	122	48	11	0	0	0	0	0	257	41	36
10:00	0	0	5	16	33	80	40	6	0	0	0	0	0	180	41	36
11:00	0	2	3	6	39	89	43	7	1	0	0	0	0	190	41	37
12 PM	0	0	8	15	28	92	51	7	2	0	0	0	0	203	41	37
13:00	0	2	3	11	37	82	45	11	1	0	0	0	0	192	42	37
14:00	2	1	3	10	33	84	46	7	1	0	0	0	0	187	41	36
15:00	2	6	15	32	68	90	50	6	0	0	1	0	0	270	40	34
16:00	0	1	4	15	63	130	36	3	0	0	0	0	0	252	39	36
17:00	0	1	7	14	78	132	24	3	0	0	0	0	0	259	38	35
18:00	0	1	2	3	41	119	36	0	0	0	0	0	0	202	40	36
19:00	0	2	5	7	17	63	29	2	1	0	0	0	0	126	41	36
20:00	0	0	2	1	18	38	13	1	0	0	0	0	0	73	40	36
21:00	0	0	0	5	5	26	7	0	0	0	0	0	0	43	39	36
22:00	0	0	0	4	11	22	21	2	2	0	0	0	0	62	42	38
23:00	0	0	0	2	4	9	11	2	0	1	0	0	0	29	42	39

%	0.4%	1.0%	2.0%	5.6%	20.4%	48.3%	19.5%	2.5%	0.3%	0.1%	0.0%	0.0%	0.0%			
AM Peak	07:00	07:00	07:00	08:00	08:00	07:00	08:00	09:00	04:00	05:00				07:00		
Vol.	4	15	9	36	83	231	66	11	1	1				402		
Midday Peak	14:00	11:00	12:00	12:00	11:00	12:00	12:00	13:00	12:00					12:00		
Vol.	2	2	8	15	39	92	51	11	2					203		
PM Peak	15:00	15:00	15:00	15:00	17:00	17:00	15:00	15:00	22:00	23:00	15:00			15:00		
Vol.	2	6	15	32	78	132	50	6	2	1	1			270		
% ile			15th Percentile :			30 MPH										
			50th Percentile :			36 MPH										
			85th Percentile :			40 MPH										
			95th Percentile :			43 MPH										

Stats

10 MPH Pace Speed : 32-41 MPH

Number in Pace : 2405

Percent in Pace : 67.8%

Number of Vehicles > 35 MPH : 2106

Percent of Vehicles > 35 MPH : 59.4%

Mean Speed(Average) : 36 MPH



PRECISION
D A T A
INDUSTRIES, LLC

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123082 E Speed
Site Code: TBA

Bedford Street (Route 62)
west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

EB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/17/1																
2	0	0	0	0	5	8	2	1	0	0	0	0	0	16	39	37
01:00	0	0	0	1	2	3	1	0	0	0	0	0	0	7	37	35
02:00	0	0	0	0	0	0	2	0	0	0	0	0	0	2	*	42
03:00	0	0	0	1	2	2	1	0	0	0	0	0	0	6	*	34
04:00	0	0	0	0	0	1	2	1	0	0	0	0	0	4	*	42
05:00	0	0	0	0	2	8	7	3	0	0	0	0	0	20	44	40
06:00	0	0	1	1	3	9	17	3	0	0	0	0	0	34	43	39
07:00	0	0	0	0	13	40	17	6	0	0	0	0	0	76	42	38
08:00	0	0	1	4	19	61	38	10	0	0	0	0	0	133	42	38
09:00	0	0	7	9	35	74	26	6	0	0	0	0	0	157	40	36
10:00	2	4	4	34	73	77	25	1	0	0	0	0	0	220	38	33
11:00	0	4	7	20	40	86	45	3	0	0	0	0	0	205	40	35
12 PM	2	4	5	19	56	106	43	14	0	0	0	0	0	249	41	35
13:00	0	1	4	23	42	104	49	7	1	0	0	0	0	231	41	36
14:00	6	8	16	36	70	96	35	7	0	0	0	0	0	274	39	33
15:00	0	6	8	23	48	88	29	8	0	0	0	0	0	210	40	34
16:00	0	1	2	7	52	66	25	5	0	0	0	0	0	158	40	36
17:00	0	1	3	13	46	87	22	1	0	0	0	0	0	173	39	35
18:00	0	0	0	22	26	61	27	1	0	0	0	0	0	137	40	36
19:00	0	1	0	1	20	41	11	1	0	0	0	0	0	75	39	36
20:00	0	0	0	1	15	26	13	4	0	0	0	0	0	59	42	37
21:00	0	0	1	2	16	37	7	2	0	0	0	0	0	65	39	36
22:00	0	0	1	2	25	26	11	0	0	0	0	0	0	65	39	35
23:00	0	0	0	4	6	17	8	3	4	0	0	0	0	42	46	38

%	0.4%	1.1%	2.3%	8.5%	23.5%	42.9%	17.7%	3.3%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AM Peak Vol.				09:00	09:00	09:00	09:00	08:00	08:00																09:00		
				7	9	35	74	38	10																157		
Midday Peak Vol.	14:00	14:00	14:00	14:00	14:00	14:00	12:00	13:00	12:00	13:00															14:00		
	6	8	16	36	70	106	49	14	1																274		
PM Peak Vol.		15:00	15:00	15:00	16:00	15:00	15:00	15:00	15:00	23:00															15:00		
		6	8	23	52	88	29	8	4																210		
% ile				15th Percentile :			29 MPH																				
				50th Percentile :			35 MPH																				
				85th Percentile :			40 MPH																				
				95th Percentile :			44 MPH																				

Stats

10 MPH Pace Speed : 32-41 MPH

Number in Pace : 1665

Percent in Pace : 63.6%

Number of Vehicles > 35 MPH : 1422

Percent of Vehicles > 35 MPH : 54.3%

Mean Speed(Average) : 35 MPH



PRECISION
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Bedford Street (Route 62)
west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 E Speed
Site Code: TBA

EB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
11/18/1																												
2	0	0	0	0	1	2	10	4	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	40	39
01:00	0	0	0	0	1	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	*	40
02:00	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	*	27
03:00	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	*	34
04:00	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	*	42
05:00	0	0	0	1	0	2	4	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	45	40
06:00	0	0	0	0	2	3	7	9	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	42	39
07:00	0	0	2	1	11	17	15	9	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	58	45	39
08:00	0	0	1	8	8	37	26	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	83	41	37
09:00	0	1	3	8	16	35	33	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	103	42	37
10:00	0	3	7	16	31	52	29	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	147	41	35
11:00	0	3	3	13	25	66	34	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	149	41	36
12 PM	1	2	10	24	41	84	48	6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	217	41	35
13:00	1	6	9	33	38	98	34	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	222	39	34
14:00	1	5	13	15	33	75	28	5	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	176	40	34
15:00	0	3	8	37	49	83	35	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	216	39	34
16:00	0	0	1	8	42	82	28	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	166	40	36
17:00	0	3	4	6	26	46	21	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	108	40	35
18:00	0	0	1	8	16	47	20	5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	98	41	37
19:00	0	1	0	6	15	34	17	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	78	41	37
20:00	0	0	2	6	7	36	9	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	63	40	36
21:00	0	0	0	0	6	19	14	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41	42	39
22:00	0	0	1	1	6	11	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	39	36
23:00	0	0	0	1	0	6	12	5	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	48	42

%	0.1%	1.3%	3.3%	9.6%	18.4%	41.7%	20.9%	3.9%	0.6%	0.2%	0.0%	0.0%	0.0%															
AM Peak		09:00	09:00	08:00	09:00	08:00	09:00	07:00	07:00	00:00																09:00		
Vol.		1	3	8	16	37	33	9	2	1																103		
Midday Peak	12:00	13:00	14:00	13:00	12:00	13:00	12:00	12:00	11:00	12:00	14:00															13:00		
Vol.	1	6	13	33	41	98	48	6	2	1	1															222		
PM Peak		15:00	15:00	15:00	15:00	15:00	15:00	16:00	23:00	18:00																15:00		
Vol.		3	8	37	49	83	35	5	3	1																216		
% ile				15th Percentile :		28 MPH																						
				50th Percentile :		36 MPH																						
				85th Percentile :		41 MPH																						
				95th Percentile :		44 MPH																						

Stats

10 MPH Pace Speed : 33-42 MPH

Number in Pace : 1251

Percent in Pace : 61.1%

Number of Vehicles > 35 MPH : 1179

Percent of Vehicles > 35 MPH : 57.6%

Mean Speed(Average) : 36 MPH



PRECISION
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west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 E Speed
Site Code: TBA

EB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/19/1																
2	0	0	0	0	0	2	5	2	0	0	0	0	0	9	44	42
01:00	0	0	0	0	1	3	3	0	0	0	0	0	0	7	40	38
02:00	0	0	0	0	2	0	0	0	0	0	0	0	0	2	*	32
03:00	0	0	0	0	0	0	1	0	0	0	0	0	0	1	*	42
04:00	0	0	0	1	2	5	2	2	0	0	0	0	0	12	39	38
05:00	0	0	0	0	1	17	22	5	0	0	0	0	0	45	44	40
06:00	1	0	2	8	14	108	29	2	0	0	0	0	0	164	40	37
07:00	10	5	7	16	96	186	66	6	0	0	0	0	0	392	40	34
08:00	0	0	2	33	83	232	112	6	2	0	0	0	0	470	41	37
09:00	0	1	7	12	40	148	68	5	1	0	0	0	0	282	41	37
10:00	0	1	6	10	48	61	41	4	0	0	1	0	0	172	41	36
11:00	0	1	8	8	25	88	43	4	0	0	0	0	0	177	41	36
12 PM	1	1	1	7	35	94	32	6	0	0	0	0	0	177	40	36
13:00	0	1	5	13	27	89	46	5	1	0	0	0	0	187	41	37
14:00	3	2	6	8	40	79	54	7	1	0	0	0	0	200	41	36
15:00	0	1	2	16	55	89	55	6	0	0	0	0	0	224	41	36
16:00	0	2	6	11	62	137	31	2	0	0	0	0	0	251	39	35
17:00	4	9	7	16	65	100	35	0	0	0	0	0	0	236	39	33
18:00	0	0	0	9	50	99	18	2	0	0	0	0	0	178	39	36
19:00	0	0	2	3	33	57	19	2	0	0	0	0	0	116	40	36
20:00	0	0	1	2	12	28	10	1	0	0	0	0	0	54	40	36
21:00	0	0	2	5	10	35	12	2	0	0	0	0	0	66	40	36
22:00	0	0	0	3	5	11	23	2	1	0	0	0	0	45	42	39
23:00	0	0	0	0	0	11	8	1	2	0	0	0	0	22	42	41

%	0.5%	0.7%	1.8%	5.2%	20.2%	48.1%	21.1%	2.1%	0.2%	0.0%	0.0%	0.0%	0.0%			
AM Peak	07:00	07:00	07:00	08:00	07:00	08:00	08:00	07:00	08:00					08:00		
Vol.	10	5	7	33	96	232	112	6	2					470		
Midday Peak	14:00	14:00	11:00	13:00	14:00	12:00	14:00	14:00	13:00					14:00		
Vol.	3	2	8	13	40	94	54	7	1					200		
PM Peak	17:00	17:00	17:00	15:00	17:00	16:00	15:00	15:00	23:00					16:00		
Vol.	4	9	7	16	65	137	55	6	2					251		
% ile			15th Percentile :			30 MPH										
			50th Percentile :			36 MPH										
			85th Percentile :			40 MPH										
			95th Percentile :			43 MPH										

Stats

10 MPH Pace Speed :	33-42 MPH
Number in Pace :	2385
Percent in Pace :	68.4%
Number of Vehicles > 35 MPH :	2105
Percent of Vehicles > 35 MPH :	60.3%
Mean Speed(Average) :	36 MPH



PRECISION
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west of Old Bedford Street
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Client: Toole Design Group/ C. Fink

123082 E Speed
Site Code: TBA

WB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
11/13/1																												
2	0	0	0	0	0	0	0	1	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	37	38
01:00	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	*	32
02:00	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	*	29
03:00	0	0	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	*	38
04:00	0	0	0	0	0	2	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	*	39
05:00	0	1	2	0	5	13	8	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34	44	37
06:00	0	0	1	9	15	64	26	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	118	40	37
07:00	1	2	11	12	46	130	37	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	247	40	36
08:00	0	0	10	6	49	136	62	5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	269	41	37
09:00	0	1	1	12	42	128	43	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	230	40	36
10:00	0	0	4	9	37	126	31	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	214	40	36
11:00	0	0	6	14	26	110	39	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	198	40	36
12 PM	1	1	0	1	20	99	55	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	181	41	38
13:00	1	1	2	4	43	111	43	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	213	41	37
14:00	0	1	7	24	78	104	39	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	261	40	35
15:00	1	1	3	29	94	160	41	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	335	39	35
16:00	0	0	2	34	219	227	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	506	38	34
17:00	0	0	12	90	337	173	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	623	36	33
18:00	0	0	1	41	220	179	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	457	37	34
19:00	0	0	4	19	75	95	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	206	38	34
20:00	0	1	0	4	37	53	17	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	113	39	36
21:00	0	0	1	4	15	38	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	68	39	36
22:00	0	0	1	0	9	13	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	40	36
23:00	0	0	0	0	4	7	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	42	38

%	0.1%	0.2%	1.6%	7.2%	31.7%	45.5%	12.1%	1.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%														
AM Peak	07:00	07:00	07:00	07:00	08:00	08:00	08:00	07:00	06:00	08:00																08:00		
Vol.	1	2	11	12	49	136	62	8	1	1																269		
Midday Peak	12:00	12:00	14:00	14:00	14:00	13:00	12:00	13:00																		14:00		
Vol.	1	1	7	24	78	111	55	8																		261		
PM Peak	15:00	15:00	17:00	17:00	17:00	16:00	15:00	15:00																		17:00		
Vol.	1	1	12	90	337	227	41	6																		623		

% ile
15th Percentile : 29 MPH
50th Percentile : 34 MPH
85th Percentile : 39 MPH
95th Percentile : 42 MPH

Stats
10 MPH Pace Speed : 31-40 MPH
Number in Pace : 3074
Percent in Pace : 70.9%
Number of Vehicles > 35 MPH : 2145
Percent of Vehicles > 35 MPH : 49.4%
Mean Speed(Average) : 35 MPH



PRECISION
D A T A
INDUSTRIES, LLC

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Bedford Street (Route 62)
west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 E Speed
Site Code: TBA

WB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
11/14/1																												
2	0	0	0	0	0	0	0	2	5	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	41	38
01:00	0	0	0	0	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	*	38
02:00	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	*	37
03:00	0	0	0	0	0	0	0	2	2	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	6	*	39
04:00	0	0	0	0	0	0	0	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	34	33
05:00	1	0	1	0	0	0	0	5	14	13	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	37	42	37
06:00	0	0	0	0	6	12	58	32	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	112	41	38
07:00	0	0	5	5	21	117	55	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	209	41	38
08:00	0	3	13	13	47	158	65	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	308	41	36
09:00	0	0	3	2	22	125	57	8	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	219	41	38
10:00	0	0	4	8	36	86	43	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	184	41	37
11:00	0	1	2	9	24	115	53	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	211	41	37
12 PM	0	0	2	5	53	101	55	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	228	41	37
13:00	0	0	7	5	19	122	73	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	229	41	38
14:00	0	1	2	10	49	141	52	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	258	40	37
15:00	0	8	31	50	85	132	42	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	350	39	33
16:00	1	4	5	30	145	256	50	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	497	39	35
17:00	0	2	7	44	271	246	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	594	37	34
18:00	0	0	0	14	144	198	31	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	390	38	35
19:00	0	0	3	19	89	91	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	218	38	34
20:00	0	0	0	4	32	61	17	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	116	39	36
21:00	0	2	2	4	20	27	15	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73	41	35
22:00	0	0	1	1	6	19	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	40	37
23:00	0	0	0	2	2	12	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	44	38

%	0.0%	0.5%	2.0%	5.3%	25.3%	48.3%	16.5%	1.9%	0.1%	0.0%	0.0%	0.0%	0.0%															
AM Peak	05:00	08:00	08:00	08:00	08:00	08:00	08:00	08:00	09:00																	08:00		
Vol.	1	3	13	13	47	158	65	9	2																	308		
Midday Peak		11:00	13:00	14:00	12:00	14:00	13:00	12:00																		14:00		
Vol.		1	7	10	53	141	73	12																		258		
PM Peak	16:00	15:00	15:00	15:00	17:00	16:00	16:00	16:00																		17:00		
Vol.	1	8	31	50	271	256	50	6																		594		
% ile			15th Percentile :			30 MPH																						
			50th Percentile :			35 MPH																						
			85th Percentile :			40 MPH																						
			95th Percentile :			43 MPH																						

Stats

10 MPH Pace Speed : 32-41 MPH

Number in Pace : 3022

Percent in Pace : 69.9%

Number of Vehicles > 35 MPH : 2424

Percent of Vehicles > 35 MPH : 56.1%

Mean Speed(Average) : 36 MPH



PRECISION
D A T A
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Bedford Street (Route 62)
west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 E Speed
Site Code: TBA

WB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/15/1																
2	0	0	0	1	3	1	1	1	0	0	0	0	0	7	32	36
01:00	0	0	0	0	1	1	1	0	0	0	0	0	0	3	*	37
02:00	0	0	1	0	0	2	1	0	0	0	0	0	0	4	*	35
03:00	0	0	0	0	3	4	0	0	0	0	0	0	0	7	36	35
04:00	0	0	0	0	0	0	2	0	0	0	0	0	0	2	*	42
05:00	0	0	2	0	3	11	9	2	1	0	0	0	0	28	42	38
06:00	0	0	1	2	15	66	32	6	0	0	0	0	0	122	41	38
07:00	0	1	2	7	48	116	64	4	0	0	0	0	0	242	41	37
08:00	0	2	3	10	56	134	43	6	0	0	0	0	0	254	40	36
09:00	0	0	4	7	52	126	36	4	0	0	0	0	0	229	40	36
10:00	0	0	5	4	28	95	49	5	1	0	0	0	0	187	41	37
11:00	0	0	3	5	27	107	58	4	0	0	0	0	0	204	41	37
12 PM	0	0	3	6	30	98	65	5	3	0	0	0	0	210	42	38
13:00	0	0	4	5	25	108	69	10	0	0	0	0	0	221	42	38
14:00	1	0	7	11	58	137	63	6	0	0	0	0	0	283	41	36
15:00	4	3	7	16	97	162	56	6	0	0	0	0	0	351	40	35
16:00	0	1	5	21	228	209	62	3	0	0	0	0	0	529	39	35
17:00	0	0	6	44	260	236	24	1	0	0	0	0	0	571	37	34
18:00	0	1	1	46	199	163	30	2	0	0	0	0	0	442	38	34
19:00	0	0	2	7	65	92	23	2	0	0	0	0	0	191	39	35
20:00	0	0	5	2	34	69	15	2	0	0	0	0	0	127	39	36
21:00	0	1	0	7	26	49	14	0	2	0	0	0	0	99	39	36
22:00	0	0	0	3	8	22	7	1	0	0	0	0	0	41	40	36
23:00	0	0	0	2	6	8	5	0	0	0	0	0	0	21	41	36

%	0.1%	0.2%	1.4%	4.7%	29.1%	46.1%	16.7%	1.6%	0.2%	0.0%	0.0%	0.0%	0.0%															
AM Peak		08:00	09:00	08:00	08:00	08:00	07:00	06:00	05:00																	08:00		
Vol.		2	4	10	56	134	64	6	1																	254		
Midday Peak	14:00		14:00	14:00	14:00	14:00	13:00	13:00	12:00																	14:00		
Vol.	1		7	11	58	137	69	10	3																	283		
PM Peak	15:00	15:00	15:00	18:00	17:00	17:00	16:00	15:00	21:00																	17:00		
Vol.	4	3	7	46	260	236	62	6	2																	571		
% ile			15th Percentile :			30 MPH																						
			50th Percentile :			35 MPH																						
			85th Percentile :			40 MPH																						
			95th Percentile :			43 MPH																						

Stats

10 MPH Pace Speed : 31-40 MPH

Number in Pace : 3080

Percent in Pace : 70.4%

Number of Vehicles > 35 MPH : 2385

Percent of Vehicles > 35 MPH : 54.5%

Mean Speed(Average) : 36 MPH



PRECISION
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Bedford Street (Route 62)
west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 E Speed
Site Code: TBA

WB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/16/1																
2	0	0	0	0	3	5	5	0	0	0	0	0	0	13	42	38
01:00	0	0	0	0	1	1	0	1	0	0	0	0	0	3	*	39
02:00	0	0	0	0	0	1	0	0	1	0	0	0	0	2	*	45
03:00	0	0	0	0	3	2	0	1	0	0	0	0	0	6	33	36
04:00	0	0	0	0	1	1	0	0	0	0	0	0	0	2	*	34
05:00	0	0	3	0	3	15	7	3	1	0	0	0	0	32	43	38
06:00	0	0	0	3	19	67	25	4	0	0	0	0	0	118	41	37
07:00	0	0	0	8	29	114	60	5	0	0	0	0	0	216	41	38
08:00	0	2	6	10	47	138	59	4	0	0	0	0	0	266	40	36
09:00	2	0	3	10	25	75	62	9	2	0	0	0	0	188	42	37
10:00	0	0	3	5	31	92	47	7	1	0	0	0	0	186	41	37
11:00	0	0	5	11	22	112	64	3	0	0	0	0	0	217	41	37
12 PM	0	1	5	5	41	108	72	9	0	0	0	0	0	241	42	37
13:00	0	0	1	4	67	100	52	5	0	0	0	0	0	229	41	37
14:00	0	6	3	24	46	127	55	8	0	0	0	0	0	269	40	36
15:00	1	3	11	13	106	183	55	9	0	0	0	0	0	381	40	35
16:00	0	1	5	46	185	188	37	1	0	0	0	0	0	463	38	34
17:00	0	0	3	37	262	211	18	1	0	0	0	0	0	532	37	34
18:00	0	0	2	13	122	149	25	3	0	0	0	0	0	314	38	35
19:00	0	0	1	9	55	72	18	4	0	0	0	0	0	159	39	35
20:00	0	0	0	5	30	50	17	2	1	0	0	0	0	105	40	36
21:00	0	0	0	3	26	30	12	0	0	0	0	0	0	71	39	36
22:00	0	1	0	11	20	26	9	3	0	0	0	0	0	70	39	35
23:00	0	0	0	2	8	11	9	0	0	0	0	0	0	30	41	36

%	0.1%	0.3%	1.2%	5.3%	28.0%	45.7%	17.2%	2.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%														
AM Peak	09:00	08:00	08:00	08:00	08:00	08:00	09:00	09:00	09:00																	08:00		
Vol.	2	2	6	10	47	138	62	9	2																	266		
Midday Peak		14:00	11:00	14:00	13:00	14:00	12:00	12:00																		14:00		
Vol.		6	5	24	67	127	72	9																		269		
PM Peak	15:00	15:00	15:00	16:00	17:00	17:00	15:00	15:00	20:00																	17:00		
Vol.	1	3	11	46	262	211	55	9	1																	532		
% ile			15th Percentile :			30 MPH																						
			50th Percentile :			35 MPH																						
			85th Percentile :			40 MPH																						
			95th Percentile :			43 MPH																						

Stats

10 MPH Pace Speed : 31-40 MPH

Number in Pace : 2851

Percent in Pace : 69.3%

Number of Vehicles > 35 MPH : 2264

Percent of Vehicles > 35 MPH : 55.1%

Mean Speed(Average) : 36 MPH



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Bedford Street (Route 62)
west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 E Speed
Site Code: TBA

WB

Start Time	14	15	20	25	30	35	40	45	50	55	60	65	70	Total	85th % ile	Ave Speed
11/17/1																
2	0	0	0	1	5	10	7	1	0	0	0	0	0	24	41	37
01:00	0	0	0	0	2	1	2	0	0	0	0	0	0	5	*	37
02:00	0	0	0	1	4	0	2	0	0	0	0	0	0	7	32	34
03:00	0	0	0	0	1	1	1	0	0	0	0	0	0	3	*	37
04:00	0	0	0	0	2	4	1	1	0	0	0	0	0	8	38	38
05:00	0	0	0	0	0	2	3	3	0	0	0	0	0	8	45	43
06:00	0	0	2	2	7	21	16	2	1	0	0	0	0	51	42	38
07:00	0	1	1	1	7	36	30	5	0	0	0	0	0	81	43	38
08:00	0	1	2	3	23	52	40	3	0	0	0	0	0	124	42	37
09:00	2	0	5	12	42	98	23	5	0	0	0	0	0	187	39	35
10:00	4	4	11	10	84	69	18	0	1	0	0	0	0	201	38	33
11:00	0	0	9	13	68	120	44	7	0	0	0	0	0	261	40	36
12 PM	1	1	5	14	48	102	54	9	0	0	0	0	0	234	41	36
13:00	0	0	6	13	55	107	54	5	0	0	0	0	0	240	41	36
14:00	0	0	6	23	57	115	39	6	0	0	0	0	0	246	40	36
15:00	0	0	11	28	91	165	43	2	0	0	0	0	0	340	39	35
16:00	0	1	11	20	78	127	35	8	1	0	0	0	0	281	39	35
17:00	0	0	3	7	44	83	27	1	0	0	0	0	0	165	39	36
18:00	0	0	1	13	64	65	17	1	1	0	0	0	0	162	38	35
19:00	0	3	0	4	42	55	10	0	0	0	0	0	0	114	38	34
20:00	0	0	0	2	32	51	19	5	0	0	0	0	0	109	41	37
21:00	0	0	4	6	23	28	11	1	1	0	0	0	0	74	39	35
22:00	0	0	0	3	21	28	5	1	0	0	0	0	0	58	39	35
23:00	0	0	0	2	11	17	5	1	0	0	0	0	0	36	40	36

%	0.2%	0.4%	2.6%	5.9%	26.9%	44.9%	16.8%	2.2%	0.2%	0.0%	0.0%	0.0%	0.0%			
AM Peak	09:00	07:00	09:00	09:00	09:00	09:00	08:00	07:00	06:00					09:00		
Vol.	2	1	5	12	42	98	40	5	1					187		
Midday Peak	12:00	12:00	11:00	14:00	11:00	11:00	12:00	12:00						11:00		
Vol.	1	1	9	23	68	120	54	9						261		
PM Peak		19:00	15:00	15:00	15:00	15:00	15:00	16:00	16:00					15:00		
Vol.		3	11	28	91	165	43	8	1					340		
% ile			15th Percentile :			29 MPH										
			50th Percentile :			35 MPH										
			85th Percentile :			40 MPH										
			95th Percentile :			43 MPH										

Stats

10 MPH Pace Speed : 31-40 MPH

Number in Pace : 2041

Percent in Pace : 67.6%

Number of Vehicles > 35 MPH : 1636

Percent of Vehicles > 35 MPH : 54.2%

Mean Speed(Average) : 36 MPH



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

Bedford Street (Route 62)
west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 E Speed
Site Code: TBA

WB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
11/18/1																
2	0	0	0	0	4	6	3	3	0	0	0	0	0	16	44	39
01:00	0	0	0	1	2	5	2	0	0	0	0	0	0	10	39	36
02:00	0	0	0	0	1	1	1	0	0	0	0	0	0	3	*	37
03:00	0	0	0	0	2	2	1	0	0	0	0	0	0	5	*	36
04:00	0	0	0	0	1	1	0	0	0	0	0	0	0	2	*	34
05:00	0	0	0	0	0	2	1	1	0	0	0	0	0	4	*	41
06:00	0	0	0	1	4	8	10	3	0	0	0	0	0	26	43	39
07:00	0	0	5	4	11	17	17	2	0	0	0	0	0	56	42	36
08:00	0	0	4	2	6	37	27	9	2	0	0	0	0	87	43	39
09:00	0	0	4	12	17	53	38	9	1	0	0	0	0	134	42	37
10:00	0	0	6	7	22	56	35	4	2	0	0	0	0	132	42	37
11:00	0	1	9	11	34	95	44	6	0	0	0	0	0	200	41	36
12 PM	0	2	13	14	30	85	48	4	0	0	0	0	0	196	41	36
13:00	0	0	6	22	30	102	52	1	1	0	0	0	0	214	40	36
14:00	0	0	14	16	47	115	50	6	0	0	0	0	0	248	40	36
15:00	0	3	10	24	57	113	38	2	0	0	0	0	0	247	39	35
16:00	0	1	15	14	77	86	21	2	1	0	0	0	0	217	38	34
17:00	0	1	4	10	26	67	20	2	0	0	0	0	0	130	39	35
18:00	0	0	1	10	45	61	18	2	0	0	0	0	0	137	39	35
19:00	0	0	0	10	20	48	13	1	0	0	0	0	0	92	39	36
20:00	0	0	2	4	27	36	20	1	2	0	0	0	0	92	40	36
21:00	0	1	0	2	13	25	5	1	1	0	0	0	0	48	39	36
22:00	0	0	0	1	6	8	3	0	0	0	0	0	0	18	39	36
23:00	0	0	0	0	1	8	3	3	0	0	0	0	0	15	44	40

%	0.0%	0.4%	4.0%	7.1%	20.7%	44.5%	20.2%	2.7%	0.4%	0.0%	0.0%	0.0%	0.0%			
AM Peak Vol.			07:00	09:00	09:00	09:00	09:00	08:00	08:00					09:00		
			5	12	17	53	38	9	2					134		
Midday Peak Vol.		12:00	14:00	13:00	14:00	14:00	13:00	11:00	13:00					14:00		
		2	14	22	47	115	52	6	1					248		
PM Peak Vol.		15:00	16:00	15:00	16:00	15:00	15:00	23:00	20:00					15:00		
		3	15	24	77	113	38	3	2					247		
% ile			15th Percentile :			29 MPH										
			50th Percentile :			35 MPH										
			85th Percentile :			41 MPH										
			95th Percentile :			44 MPH										

Stats

10 MPH Pace Speed : 32-41 MPH

Number in Pace : 1512

Percent in Pace : 64.9%

Number of Vehicles > 35 MPH : 1347

Percent of Vehicles > 35 MPH : 57.8%

Mean Speed(Average) : 36 MPH



PRECISION
D A T A
INDUSTRIES, LLC

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Bedford Street (Route 62)
west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink

123082 E Speed
Site Code: TBA

WB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
11/19/1																												
2	0	0	0	0	0	0	0	2	4	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	44	40
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
02:00	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	36	37
03:00	0	0	0	0	0	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	*	39
04:00	0	0	1	1	2	5	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	41	36
05:00	0	0	2	0	1	13	8	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26	41	38
06:00	0	0	0	3	12	59	31	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	111	42	38
07:00	0	0	3	13	27	105	58	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	211	41	37
08:00	0	1	3	14	34	142	68	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	267	41	37
09:00	0	2	3	7	32	129	51	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	230	41	37
10:00	0	0	2	7	48	87	47	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	193	41	37
11:00	0	0	4	4	32	119	33	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	195	40	37
12 PM	0	0	8	5	39	120	58	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	235	41	37
13:00	0	1	2	4	33	105	59	11	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	216	42	38
14:00	0	1	3	8	57	155	53	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	285	40	37
15:00	2	0	5	19	92	184	77	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	385	40	36
16:00	2	0	6	13	166	249	48	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	486	39	35
17:00	0	0	6	45	304	223	22	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	602	37	34
18:00	0	1	7	33	149	181	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	399	38	34
19:00	0	0	1	6	50	127	30	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	217	39	36
20:00	0	0	1	2	26	54	22	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	108	40	37
21:00	0	1	0	4	8	36	13	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	63	41	36
22:00	0	0	0	1	10	14	11	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39	42	38
23:00	0	0	0	0	1	7	9	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	43	40

%	0.1%	0.2%	1.3%	4.4%	26.1%	49.1%	17.0%	1.8%	0.1%	0.0%	0.0%	0.0%	0.0%															
AM Peak Vol.		09:00	07:00	08:00	08:00	08:00	08:00	06:00	05:00																	08:00		
		2	3	14	34	142	68	6	1																	267		
Midday Peak Vol.		13:00	12:00	14:00	14:00	14:00	13:00	13:00	13:00																	14:00		
		1	8	8	57	155	59	11	1																	285		
PM Peak Vol.	15:00	18:00	18:00	17:00	17:00	16:00	15:00	15:00	15:00																	17:00		
	2	1	7	45	304	249	77	4	2																	602		
% ile			15th Percentile :			30 MPH																						
			50th Percentile :			35 MPH																						
			85th Percentile :			40 MPH																						
			95th Percentile :			43 MPH																						

Stats

10 MPH Pace Speed : 32-41 MPH

Number in Pace : 3086

Percent in Pace : 71.5%

Number of Vehicles > 35 MPH : 2467

Percent of Vehicles > 35 MPH : 57.1%

Mean Speed(Average) : 36 MPH

Bedford Street (Route 62)
west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink



123082 E Volume
Site Code: TBA

Start Time	13-Nov-12		14-Nov-12		15-Nov-12		16-Nov-12		17-Nov-12		18-Nov-12		19-Nov-12		Week Average	
	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
12:00 AM	2	6	3	11	6	7	11	13	16	24	19	16	9	12	9	13
01:00	8	1	6	4	7	3	9	3	7	5	7	10	7	0	7	4
02:00	1	2	1	1	3	4	2	2	2	7	1	3	2	3	2	3
03:00	2	4	1	6	3	7	3	6	6	3	3	5	1	3	3	5
04:00	7	6	6	7	8	2	9	2	4	8	3	2	12	13	7	6
05:00	52	34	56	37	54	28	45	32	20	8	16	4	45	26	41	24
06:00	159	118	155	112	183	122	153	118	34	51	24	26	164	111	125	94
07:00	371	247	404	209	406	242	402	216	76	81	58	56	392	211	301	180
08:00	450	269	456	308	456	254	388	266	133	124	83	87	470	267	348	225
09:00	328	230	310	219	289	229	257	188	157	187	103	134	282	230	247	202
10:00	197	214	181	184	216	187	180	186	220	201	147	132	172	193	188	185
11:00	190	198	208	211	195	204	190	217	205	261	149	200	177	195	188	212
12:00 PM	181	181	225	228	194	210	203	241	249	234	217	196	177	235	207	218
01:00	175	213	191	229	199	221	192	229	231	240	222	214	187	216	200	223
02:00	210	261	196	258	184	283	187	269	274	246	176	248	200	285	204	264
03:00	235	335	215	350	251	351	270	381	210	340	216	247	224	385	232	341
04:00	238	506	250	497	229	529	252	463	158	281	166	217	251	486	221	426
05:00	241	623	252	594	279	571	259	532	173	165	108	130	236	602	221	460
06:00	183	457	176	390	181	442	202	314	137	162	98	137	178	399	165	329
07:00	106	206	111	218	109	191	126	159	75	114	78	92	116	217	103	171
08:00	78	113	83	116	83	127	73	105	59	109	63	92	54	108	70	110
09:00	45	68	67	73	66	99	43	71	65	74	41	48	66	63	56	71
10:00	32	29	33	36	37	41	62	70	65	58	23	18	45	39	42	42
11:00	23	17	23	25	35	21	29	30	42	36	27	15	22	19	29	23
Total	3514	4338	3609	4323	3673	4375	3547	4113	2618	3019	2048	2329	3489	4318	3216	3831
Day	7852		7932		8048		7660		5637		4377		7807		7047	
AM Peak	08:00	08:00	08:00	08:00	08:00	08:00	07:00	08:00	10:00	11:00	11:00	11:00	08:00	08:00	08:00	08:00
Vol.	450	269	456	308	456	254	402	266	220	261	149	200	470	267	348	225
PM Peak	17:00	17:00	17:00	17:00	17:00	17:00	15:00	17:00	14:00	15:00	13:00	14:00	16:00	17:00	15:00	17:00
Vol.	241	623	252	594	279	571	270	532	274	340	222	248	251	602	232	460

Comb. Total	7852	7932	8048	7660	5637	4377	7807	7047
ADT	ADT 7,045		AADT 7,045					

Bedford Street (Route 62)
west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink



123082 E Volume
Site Code: TBA

Start	EB		WB		Combined		13-Nov-12
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	Tue
12:00	1	44	2	53	3	97	
12:15	0	39	3	40	3	79	
12:30	0	46	1	47	1	93	
12:45	1	52	0	41	1	93	362
01:00	0	43	0	43	0	86	
01:15	4	46	1	55	5	101	
01:30	2	41	0	61	2	102	
01:45	2	45	0	54	2	99	388
02:00	0	49	0	57	0	106	
02:15	0	43	0	55	0	98	
02:30	0	66	0	73	0	139	
02:45	1	52	2	76	3	128	471
03:00	0	46	1	81	1	127	
03:15	1	58	1	74	2	132	
03:30	0	62	2	94	2	156	
03:45	1	69	0	86	1	155	570
04:00	2	53	2	96	4	149	
04:15	1	68	0	121	1	189	
04:30	0	63	2	131	2	194	
04:45	4	54	2	158	6	212	744
05:00	4	52	3	153	7	205	
05:15	10	80	4	169	14	249	
05:30	15	49	13	168	28	217	
05:45	23	60	14	133	37	193	864
06:00	25	62	18	136	43	198	
06:15	28	56	26	120	54	176	
06:30	44	35	32	100	76	135	
06:45	62	30	42	101	104	131	640
07:00	79	29	58	76	137	105	
07:15	79	22	55	49	134	71	
07:30	91	35	57	42	148	77	
07:45	122	20	77	39	199	59	312
08:00	122	12	69	31	191	43	
08:15	118	22	59	27	177	49	
08:30	105	27	75	28	180	55	
08:45	105	17	66	27	171	44	191
09:00	114	8	70	21	184	29	
09:15	68	8	47	19	115	27	
09:30	76	22	52	18	128	40	
09:45	70	7	61	10	131	17	113
10:00	55	11	53	12	108	23	
10:15	55	14	48	6	103	20	
10:30	51	4	47	6	98	10	
10:45	36	3	66	5	102	8	61
11:00	46	9	50	6	96	15	
11:15	44	5	45	3	89	8	
11:30	50	7	55	3	105	10	
11:45	50	2	48	5	98	7	40
Total	1767	1747	1329	3009	3096	4756	
Percent	57.1%	36.7%	42.9%	63.3%			
Day Total	3514		4338		7852		
Peak	07:45	03:45	07:45	04:45	07:45	04:45	
Vol.	467	253	280	648	747	883	
P.H.F.	0.957	0.917	0.909	0.959	0.938	0.887	

Bedford Street (Route 62)
west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink



123082 E Volume
Site Code: TBA

Start		EB		WB		Combined		14-Nov-12 Wed	
Time	A.M.		P.M.	A.M.	P.M.	A.M.	P.M.		
12:00	2		45	5	49	7	94		
12:15	1		66	5	57	6	123		
12:30	0		51	1	68	1	119		
12:45	0	3	63	0	11	54	228	0	14
01:00	1		50	1	40	2	90		453
01:15	2		44	1	69	3	113		
01:30	3		51	0	67	3	118		
01:45	0	6	46	2	4	53	229	2	10
02:00	1		36	1	59	2	95		420
02:15	0		51	0	58	0	109		
02:30	0		50	0	77	0	127		
02:45	0	1	59	0	1	64	258	0	2
03:00	0		58	1	70	1	128		454
03:15	0		54	1	101	1	155		
03:30	0		53	4	75	4	128		
03:45	1	1	50	0	6	104	350	1	7
04:00	4		60	0	102	4	162		565
04:15	0		63	0	124	0	187		
04:30	0		56	2	133	2	189		
04:45	2	6	71	5	7	138	497	7	13
05:00	2		65	2	139	4	204		747
05:15	12		74	8	161	20	235		
05:30	16		58	14	156	30	214		
05:45	26	56	55	13	37	138	594	39	93
06:00	18		48	16	112	34	160		846
06:15	33		58	21	109	54	167		
06:30	40		36	32	99	72	135		
06:45	64	155	34	43	112	70	390	107	267
07:00	97		36	43	79	140	115		566
07:15	85		26	48	67	133	93		
07:30	95		25	45	34	140	59		
07:45	127	404	24	73	209	38	218	200	613
08:00	105		25	59	33	164	58		329
08:15	101		15	83	35	184	50		
08:30	118		22	88	22	206	44		
08:45	132	456	21	78	308	26	116	210	764
09:00	111		16	52	15	163	31		199
09:15	75		10	70	18	145	28		
09:30	64		17	54	22	118	39		
09:45	60	310	24	43	219	18	73	103	529
10:00	49		11	42	13	91	24		140
10:15	51		9	42	10	93	19		
10:30	41		6	61	9	102	15		
10:45	40	181	7	39	184	4	36	79	365
11:00	50		6	35	11	85	17		69
11:15	57		6	55	7	112	13		
11:30	43		4	60	5	103	9		
11:45	58	208	7	61	211	2	25	119	419
Total	1787		1822	1309	3014	3096	4836		
Percent	57.7%		37.7%	42.3%	62.3%				
Day Total		3609		4323		7932			
Peak	08:15		04:45	08:00	04:45	08:00	04:45		
Vol.	462		268	308	594	764	862		
P.H.F.	0.875		0.905	0.875	0.922	0.910	0.917		

Bedford Street (Route 62)
west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink



123082 E Volume
Site Code: TBA

Start		EB		WB		Combined		15-Nov-12 Thu	
Time	A.M.		P.M.	A.M.	P.M.	A.M.	P.M.		
12:00	2		48	4	54	6	102		
12:15	1		44	1	34	2	78		
12:30	2		49	2	53	4	102		
12:45	1	6	53	0	69	1	122	404	
01:00	1		46	0	41	1	87		
01:15	3		49	0	59	3	108		
01:30	1		49	1	60	2	109		
01:45	2	7	55	2	61	4	116	420	
02:00	1		42	2	63	3	105		
02:15	0		42	0	68	0	110		
02:30	0		49	2	76	2	125		
02:45	2	3	51	0	76	2	127	467	
03:00	0		72	1	104	1	176		
03:15	0		53	0	78	0	131		
03:30	0		49	4	82	4	131		
03:45	3	3	77	2	87	5	164	602	
04:00	3		52	0	141	3	193		
04:15	1		56	1	118	2	174		
04:30	1		58	0	123	1	181		
04:45	3	8	63	1	147	4	210	758	
05:00	3		84	1	150	4	234		
05:15	13		75	5	166	18	241		
05:30	10		67	10	149	20	216		
05:45	28	54	53	12	106	40	159	850	
06:00	24		48	16	138	40	186		
06:15	32		62	22	124	54	186		
06:30	47		44	43	102	90	146		
06:45	80	183	27	41	122	121	105	623	
07:00	79		28	61	58	140	86		
07:15	108		28	52	61	160	89		
07:30	113		32	50	39	163	71		
07:45	106	406	21	79	242	33	191	300	
08:00	112		16	58	32	170	48		
08:15	111		22	68	39	179	61		
08:30	128		24	70	27	198	51		
08:45	105	456	21	58	254	29	127	210	
09:00	93		18	69	30	162	48		
09:15	60		19	63	25	123	44		
09:30	65		16	58	29	123	45		
09:45	71	289	13	39	229	15	99	165	
10:00	55		12	45	15	100	27		
10:15	58		12	49	6	107	18		
10:30	50		10	53	6	103	16		
10:45	53	216	3	40	187	14	41	78	
11:00	43		13	44	6	87	19		
11:15	48		11	54	2	102	13		
11:30	66		4	49	8	115	12		
11:45	38	195	7	57	204	5	21	56	
Total	1826		1847	1289	3086	3115	4933		
Percent	58.6%		37.4%	41.4%	62.6%				
Day Total		3673		4375		8048			
Peak	07:45		04:45	07:45	04:45	07:45	04:45		
Vol.	457		289	275	612	732	901		
P.H.F.	0.893		0.860	0.870	0.922	0.924	0.935		

Bedford Street (Route 62)
west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink



123082 E Volume
Site Code: TBA

Start		EB		WB		Combined		16-Nov-12 Fri	
Time	A.M.		P.M.	A.M.	P.M.	A.M.	P.M.		
12:00	5		50	7	42	12	92		
12:15	2		49	2	59	4	108		
12:30	4		44	1	70	5	114		
12:45	0	11	60	3	70	3	130	24	444
01:00	1		42	0	43	1	85		
01:15	6		52	2	68	8	120		
01:30	1		51	1	66	2	117		
01:45	1	9	47	0	52	1	99	12	421
02:00	0		36	1	54	1	90		
02:15	1		54	1	69	2	123		
02:30	1		46	0	63	1	109		
02:45	0	2	51	0	83	0	134	4	456
03:00	0		67	4	95	4	162		
03:15	0		71	0	99	0	170		
03:30	1		71	1	96	2	167		
03:45	2	3	61	1	91	3	152	9	651
04:00	4		58	0	104	4	162		
04:15	0		61	0	117	0	178		
04:30	2		58	1	105	3	163		
04:45	3	9	75	1	137	4	212	11	715
05:00	2		63	2	156	4	219		
05:15	8		72	8	125	16	197		
05:30	13		69	12	134	25	203		
05:45	22	45	55	10	117	32	172	77	791
06:00	24		61	18	104	42	165		
06:15	27		56	21	91	48	147		
06:30	35		45	38	67	73	112		
06:45	67	153	40	41	52	108	92	271	516
07:00	78		37	49	53	127	90		
07:15	86		34	35	41	121	75		
07:30	109		32	59	35	168	67		
07:45	129	402	23	73	30	202	53	618	285
08:00	97		24	64	20	161	44		
08:15	107		17	62	30	169	47		
08:30	104		15	75	33	179	48		
08:45	80	388	17	65	22	145	39	654	178
09:00	69		9	62	15	131	24		
09:15	70		9	39	13	109	22		
09:30	61		12	57	27	118	39		
09:45	57	257	13	30	16	87	29	445	114
10:00	50		16	35	15	85	31		
10:15	47		14	42	23	89	37		
10:30	40		25	45	20	85	45		
10:45	43	180	7	64	12	107	19	366	132
11:00	60		8	46	7	106	15		
11:15	38		10	58	10	96	20		
11:30	45		7	58	8	103	15		
11:45	47	190	4	55	5	102	9	407	59
Total	1649		1898	1249	2864	2898	4762		
Percent	56.9%		39.9%	43.1%	60.1%				
Day Total		3547		4113		7660			
Peak	07:30		04:45	07:45	04:45	07:45	04:45		
Vol.	442		279	274	552	711	831		
P.H.F.	0.857		0.930	0.913	0.885	0.880	0.949		

Bedford Street (Route 62)
west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink



123082 E Volume
Site Code: TBA

Start	EB		WB		Combined		17-Nov-12 Sat
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
12:00	5	56	5	63	10	119	
12:15	4	68	10	64	14	132	
12:30	1	61	3	53	4	114	
12:45	6	64	6	54	12	118	483
01:00	5	51	1	57	6	108	
01:15	0	66	2	63	2	129	
01:30	2	48	1	62	3	110	
01:45	0	66	1	58	1	124	471
02:00	0	59	2	66	2	125	
02:15	1	66	3	56	4	122	
02:30	1	71	1	55	2	126	
02:45	0	78	1	69	1	147	520
03:00	4	56	2	62	6	118	
03:15	1	64	0	78	1	142	
03:30	0	40	1	69	1	109	
03:45	1	50	0	131	1	181	550
04:00	2	41	2	95	4	136	
04:15	0	37	2	64	2	101	
04:30	1	31	1	62	2	93	
04:45	1	49	3	60	4	109	439
05:00	1	40	2	49	3	89	
05:15	3	61	1	42	4	103	
05:30	6	28	3	39	9	67	
05:45	10	44	2	35	12	79	338
06:00	4	44	4	47	8	91	
06:15	5	30	13	39	18	69	
06:30	8	30	14	36	22	66	
06:45	17	33	20	40	37	73	299
07:00	16	17	18	29	34	46	
07:15	17	24	8	32	25	56	
07:30	21	16	21	27	42	43	
07:45	22	18	34	26	56	44	189
08:00	20	18	22	26	42	44	
08:15	34	21	19	37	53	58	
08:30	36	6	40	27	76	33	
08:45	43	14	43	19	86	33	168
09:00	21	16	39	20	60	36	
09:15	48	15	36	20	84	35	
09:30	47	19	52	22	99	41	
09:45	41	15	60	12	101	27	139
10:00	53	12	53	16	106	28	
10:15	38	15	50	15	88	30	
10:30	66	20	48	14	114	34	
10:45	63	18	50	13	113	31	123
11:00	52	14	68	12	120	26	
11:15	49	10	70	12	119	22	
11:30	51	12	60	6	111	18	
11:45	53	6	63	6	116	12	78
Total	880	1738	960	2059	1840	3797	
Percent	47.8%	45.8%	52.2%	54.2%			
Day Total	2618		3019		5637		
Peak	10:30	02:00	11:00	03:15	10:30	03:15	
Vol.	230	274	261	373	466	568	
P.H.F.	0.871	0.878	0.932	0.712	0.971	0.785	

Bedford Street (Route 62)
west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink



123082 E Volume
Site Code: TBA

Start		EB		WB		Combined		18-Nov-12 Sun	
Time	A.M.	P.M.		A.M.	P.M.	A.M.	P.M.		
12:00	7	47		10	37	17	84		
12:15	5	48		5	63	10	111		
12:30	3	40		1	51	4	91		
12:45	4	82	217	0	45	4	127	413	
01:00	0	47		3	53	3	100		
01:15	3	57		2	48	5	105		
01:30	2	48		3	54	5	102		
01:45	2	70	222	2	59	4	129	436	
02:00	0	55		1	63	1	118		
02:15	0	39		0	58	0	97		
02:30	1	37		2	58	3	95		
02:45	0	45	176	0	69	0	114	424	
03:00	2	53		1	49	3	102		
03:15	0	52		3	55	3	107		
03:30	0	59		1	82	1	141		
03:45	1	52	216	0	61	1	113	463	
04:00	1	51		1	62	2	113		
04:15	0	45		1	68	1	113		
04:30	1	37		0	40	1	77		
04:45	1	33	166	0	47	1	80	383	
05:00	3	28		2	44	5	72		
05:15	2	24		1	30	3	54		
05:30	1	23		0	24	1	47		
05:45	10	33	108	1	32	11	65	238	
06:00	5	33		1	37	6	70		
06:15	2	30		4	40	6	70		
06:30	8	24		8	33	16	57		
06:45	9	11	98	13	27	22	38	235	
07:00	16	24		13	29	29	53		
07:15	12	19		10	16	22	35		
07:30	14	20		15	21	29	41		
07:45	16	15	78	18	26	34	41	170	
08:00	13	22		16	25	29	47		
08:15	13	9		25	27	38	36		
08:30	31	18		21	20	52	38		
08:45	26	14	63	25	20	51	34	155	
09:00	26	19		24	12	50	31		
09:15	14	11		31	13	45	24		
09:30	29	5		39	11	68	16		
09:45	34	6	41	40	12	74	18	89	
10:00	41	8		30	6	71	14		
10:15	34	5		27	5	61	10		
10:30	40	7		39	3	79	10		
10:45	32	3	23	36	4	68	7	41	
11:00	40	9		40	6	80	15		
11:15	25	7		45	5	70	12		
11:30	38	5		52	2	90	7		
11:45	46	6	27	63	2	109	8	42	
Total	613	1435		675	1654	1288	3089		
Percent	47.6%	46.5%		52.4%	53.5%				
Day Total	2048			2329		4377			
Peak	09:45	00:45		11:00	03:30	11:00	03:30		
Vol.	149	234		200	273	349	480		
P.H.F.	0.909	0.713		0.794	0.832	0.800	0.851		

Bedford Street (Route 62)
west of Old Bedford Street
City, State: Concord, MA
Client: Toole Design Group/ C. Fink



123082 E Volume
Site Code: TBA

Start Time	EB		WB		Combined		19-Nov- 12 Mon
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
12:00	2	31	3	71	5	102	
12:15	5	40	5	50	10	90	
12:30	2	56	3	44	5	100	
12:45	0	50	1	70	1	120	412
01:00	3	58	0	54	3	112	
01:15	1	44	0	41	1	85	
01:30	0	50	0	62	0	112	
01:45	3	35	0	59	3	94	403
02:00	1	43	0	54	1	97	
02:15	1	53	1	57	2	110	
02:30	0	48	0	85	0	133	
02:45	0	56	2	89	2	145	485
03:00	1	57	2	98	3	155	
03:15	0	63	0	109	0	172	
03:30	0	47	0	88	0	135	
03:45	0	57	1	90	1	147	609
04:00	4	57	2	114	6	171	
04:15	2	62	2	107	4	169	
04:30	3	65	4	127	7	192	
04:45	3	67	5	138	8	205	737
05:00	4	61	1	156	5	217	
05:15	9	67	7	171	16	238	
05:30	13	56	11	153	24	209	
05:45	19	52	7	122	26	174	838
06:00	22	42	13	115	35	157	
06:15	33	56	26	103	59	159	
06:30	42	49	36	103	78	152	
06:45	67	31	36	78	103	109	577
07:00	86	40	43	88	129	128	
07:15	82	33	38	64	120	97	
07:30	107	27	58	29	165	56	
07:45	117	16	72	36	189	52	333
08:00	125	14	57	32	182	46	
08:15	121	9	66	18	187	27	
08:30	116	11	83	33	199	44	
08:45	108	20	61	25	169	45	162
09:00	96	24	69	19	165	43	
09:15	74	14	51	22	125	36	
09:30	54	11	54	10	108	21	
09:45	58	17	56	12	114	29	129
10:00	53	13	40	14	93	27	
10:15	42	13	36	9	78	22	
10:30	44	10	56	8	100	18	
10:45	33	9	61	8	94	17	84
11:00	48	11	51	7	99	18	
11:15	40	3	41	6	81	9	
11:30	44	4	54	6	98	10	
11:45	45	4	49	0	94	4	41
Total	1733	1756	1264	3054	2997	4810	
Percent	57.8%	36.5%	42.2%	63.5%			
Day Total	3489		4318		7807		
Peak	07:45	04:30	08:15	04:45	07:45	04:45	
Vol.	479	260	279	618	757	869	
P.H.F.	0.958	0.970	0.840	0.904	0.951	0.913	



PRECISION
D A T A
INDUSTRIES, LLC

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Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink

133213 B CLASS
Site Code: TBA

NB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
02/26/1														
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
02:00	0	2	1	0	0	0	0	0	0	0	0	0	0	3
03:00	0	5	0	0	0	0	0	0	0	0	0	0	0	5
04:00	0	7	3	0	0	0	0	0	0	0	0	0	0	10
05:00	0	26	4	0	0	0	0	0	0	1	0	0	0	31
06:00	0	78	17	2	1	1	0	1	0	0	0	0	0	100
07:00	0	127	20	2	2	0	0	0	0	0	0	0	0	151
08:00	0	61	13	2	3	0	0	0	0	0	0	0	0	79
09:00	0	59	13	1	2	0	0	1	1	0	0	0	0	77
10:00	0	48	11	1	2	0	0	2	0	1	0	0	0	65
11:00	0	67	12	1	2	0	0	0	0	0	0	0	0	82
12 PM	0	56	10	1	1	0	0	2	0	0	0	0	0	70
13:00	0	53	5	2	0	1	0	0	0	0	0	0	0	61
14:00	0	46	9	1	0	0	0	0	0	0	0	0	0	56
15:00	1	54	4	1	3	0	0	0	0	0	0	0	0	63
16:00	0	17	1	2	0	0	0	0	0	0	0	0	0	20
17:00	0	23	2	2	1	0	0	0	0	0	0	0	0	28
18:00	0	16	5	2	0	0	0	0	0	0	0	0	0	23
19:00	0	6	3	1	0	0	0	0	0	0	0	0	0	10
20:00	0	8	3	0	0	0	0	0	0	0	0	0	0	11
21:00	0	4	2	1	0	0	0	0	0	0	0	0	0	7
22:00	0	4	3	0	0	0	0	0	0	0	0	0	0	7
23:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
Total	1	770	141	22	17	2	0	6	1	2	0	0	0	962
Percent	0.1%	80.0%	14.7%	2.3%	1.8%	0.2%	0.0%	0.6%	0.1%	0.2%	0.0%	0.0%	0.0%	
AM Peak		07:00	07:00	06:00	08:00	06:00		10:00	09:00	05:00				07:00
Vol.		127	20	2	3	1		2	1	1				151
PM Peak	15:00	12:00	12:00	13:00	15:00	13:00		12:00						12:00
Vol.	1	56	10	2	3	1		2						70



PRECISION
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Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink

133213 B CLASS
Site Code: TBA

NB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
02/27/1														
3	0	1	0	0	0	0	0	0	0	0	0	0	0	1
01:00	0	1	1	0	0	0	0	0	0	0	0	0	0	2
02:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
03:00	0	3	1	0	0	0	0	0	0	0	0	0	0	4
04:00	0	6	2	0	0	0	0	0	0	0	0	0	0	8
05:00	0	20	4	0	0	0	0	0	0	1	0	0	0	25
06:00	0	65	10	2	1	0	0	0	0	0	0	0	0	78
07:00	0	108	12	2	1	0	0	0	0	0	0	0	0	123
08:00	0	53	16	2	2	0	0	0	0	0	0	0	0	73
09:00	0	54	12	1	2	0	0	1	0	0	0	0	0	70
10:00	0	38	6	1	0	0	0	0	1	0	0	0	0	46
11:00	0	51	5	1	1	1	0	0	0	0	0	0	0	59
12 PM	0	37	5	1	2	0	0	0	0	1	0	0	0	46
13:00	0	44	10	1	1	1	0	1	0	1	0	0	0	59
14:00	0	43	8	1	1	0	0	0	0	0	0	0	0	53
15:00	0	43	9	0	1	0	0	0	0	0	0	0	0	53
16:00	0	25	5	2	0	0	0	0	0	0	0	0	0	32
17:00	0	16	6	2	1	0	0	0	0	0	0	0	0	25
18:00	0	17	8	2	0	0	0	0	0	0	0	0	0	27
19:00	0	11	2	1	0	0	0	0	0	0	0	0	0	14
20:00	0	6	4	0	0	0	0	0	0	0	0	0	0	10
21:00	0	4	2	1	0	0	0	0	0	0	0	0	0	7
22:00	0	4	0	1	0	0	0	0	0	0	0	0	0	5
23:00	0	0	3	0	0	0	0	0	0	0	0	0	0	3
Total	0	652	131	21	13	2	0	2	1	3	0	0	0	825
Percent	0.0%	79.0%	15.9%	2.5%	1.6%	0.2%	0.0%	0.2%	0.1%	0.4%	0.0%	0.0%	0.0%	
AM Peak		07:00	08:00	06:00	08:00	11:00		09:00	10:00	05:00				07:00
Vol.		108	16	2	2	1		1	1	1				123
PM Peak		13:00	13:00	16:00	12:00	13:00		13:00		12:00				13:00
Vol.		44	10	2	2	1		1		1				59



PRECISION
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Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink

133213 B CLASS
Site Code: TBA

NB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
02/28/1														
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
03:00	0	4	0	0	0	0	0	0	0	0	0	0	0	4
04:00	0	7	1	0	0	0	0	0	0	0	0	0	0	8
05:00	0	32	4	0	2	0	0	0	0	1	0	0	0	39
06:00	0	74	14	2	0	0	0	0	0	0	0	0	0	90
07:00	0	132	15	2	3	1	0	0	0	0	0	0	0	153
08:00	0	72	10	2	2	0	0	0	0	0	0	0	0	86
09:00	0	51	10	2	3	0	0	1	0	0	0	0	0	67
10:00	0	40	9	1	1	1	0	0	0	0	0	0	0	52
11:00	0	60	14	2	3	0	0	0	0	0	0	0	0	79
12 PM	0	48	11	2	3	0	0	0	0	0	0	0	0	64
13:00	0	46	11	1	1	1	0	0	0	0	0	0	0	60
14:00	0	60	10	1	1	0	0	0	0	1	0	0	0	73
15:00	0	59	5	1	1	0	0	0	0	0	0	0	0	66
16:00	0	17	7	2	2	0	0	0	0	0	0	0	0	28
17:00	0	22	6	2	1	0	0	0	0	0	0	0	0	31
18:00	0	16	1	2	0	0	0	0	0	0	0	0	0	19
19:00	0	15	5	1	0	0	0	0	0	0	0	0	0	21
20:00	0	8	3	0	0	0	0	0	0	0	0	0	0	11
21:00	0	3	3	2	0	0	0	0	0	0	0	0	0	8
22:00	0	9	0	0	0	0	0	0	0	0	0	0	0	9
23:00	0	5	0	0	0	0	0	0	0	0	0	0	0	5
Total	0	781	139	25	23	3	0	1	0	2	0	0	0	974
Percent	0.0%	80.2%	14.3%	2.6%	2.4%	0.3%	0.0%	0.1%	0.0%	0.2%	0.0%	0.0%	0.0%	
AM Peak		07:00	07:00	06:00	07:00	07:00		09:00		05:00				07:00
Vol.		132	15	2	3	1		1		1				153
PM Peak		14:00	12:00	12:00	12:00	13:00				14:00				14:00
Vol.		60	11	2	3	1				1				73



PRECISION
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Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink

133213 B CLASS
Site Code: TBA

NB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
03/01/1														
3	0	2	0	0	0	0	0	0	0	0	0	0	0	2
01:00	0	3	0	0	0	0	0	0	0	0	0	0	0	3
02:00	0	3	1	0	0	0	0	0	0	0	0	0	0	4
03:00	0	4	0	0	0	0	0	0	0	0	0	0	0	4
04:00	0	9	2	0	0	0	0	1	0	0	0	0	0	12
05:00	0	23	5	0	0	0	0	0	0	0	0	0	0	28
06:00	0	70	10	2	2	0	0	0	0	0	0	0	0	84
07:00	1	115	16	2	1	0	0	0	0	0	0	0	0	135
08:00	0	77	14	2	3	0	0	0	0	0	0	0	0	96
09:00	0	60	13	2	3	0	0	1	0	0	0	0	0	79
10:00	0	39	14	1	2	0	0	1	0	1	0	0	0	58
11:00	0	60	10	1	3	0	0	0	0	0	0	0	0	74
12 PM	0	48	13	1	2	1	0	0	0	1	0	0	0	66
13:00	0	56	15	1	0	1	0	0	0	0	0	0	0	73
14:00	0	44	2	1	0	0	0	1	0	0	0	0	0	48
15:00	0	42	5	1	2	0	0	0	0	0	0	0	0	50
16:00	0	19	6	2	0	0	0	0	0	0	0	0	0	27
17:00	0	18	5	2	1	0	0	0	0	0	0	0	0	26
18:00	0	11	2	2	0	0	0	0	0	0	0	0	0	15
19:00	0	5	1	1	1	0	0	0	0	0	0	0	0	8
20:00	0	3	1	0	0	0	0	0	0	0	0	0	0	4
21:00	0	8	1	1	0	0	0	0	0	0	0	0	0	10
22:00	0	6	0	0	0	0	0	0	0	0	0	0	0	6
23:00	1	4	0	0	0	0	0	0	0	0	0	0	0	5
Total	2	729	136	22	20	2	0	4	0	2	0	0	0	917
Percent	0.2%	79.5%	14.8%	2.4%	2.2%	0.2%	0.0%	0.4%	0.0%	0.2%	0.0%	0.0%	0.0%	
AM Peak	07:00	07:00	07:00	06:00	08:00			04:00		10:00				07:00
Vol.	1	115	16	2	3			1		1				135
PM Peak	23:00	13:00	13:00	16:00	12:00	12:00		14:00		12:00				13:00
Vol.	1	56	15	2	2	1		1		1				73



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133213 B CLASS
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NB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
03/02/1														
3	0	2	1	0	0	0	0	0	0	0	0	0	0	3
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	4	0	0	0	0	0	0	0	0	0	0	0	4
04:00	0	2	1	0	0	0	0	0	0	0	0	0	0	3
05:00	0	10	2	0	0	0	0	0	0	1	0	0	0	13
06:00	0	23	4	0	0	0	0	0	0	0	0	0	0	27
07:00	0	33	3	1	1	0	0	0	0	1	0	0	0	39
08:00	0	24	5	2	1	0	0	0	0	1	0	0	0	33
09:00	0	46	5	2	2	0	0	0	0	1	0	0	0	56
10:00	0	33	1	2	1	0	0	0	0	0	0	0	0	37
11:00	0	39	1	1	0	0	0	0	0	0	0	0	0	41
12 PM	0	39	6	1	0	0	0	0	0	0	0	0	0	46
13:00	0	27	2	2	0	0	0	0	0	0	0	0	0	31
14:00	0	42	4	2	0	0	0	0	0	0	0	0	0	48
15:00	0	16	1	2	0	0	0	0	0	0	0	0	0	19
16:00	0	17	4	3	0	0	0	0	0	0	0	0	0	24
17:00	0	13	3	2	1	0	0	0	0	0	0	0	0	19
18:00	0	5	3	2	0	0	0	0	0	0	0	0	0	10
19:00	0	7	2	2	0	0	0	0	0	0	0	0	0	11
20:00	0	5	1	1	0	0	0	0	0	0	0	0	0	7
21:00	0	2	3	0	0	0	0	0	0	0	0	0	0	5
22:00	0	1	5	0	0	0	0	0	0	0	0	0	0	6
23:00	0	2	1	0	0	0	0	0	0	0	0	0	0	3
Total	0	392	58	25	6	0	0	0	0	4	0	0	0	485
Percent	0.0%	80.8%	12.0%	5.2%	1.2%	0.0%	0.0%	0.0%	0.0%	0.8%	0.0%	0.0%	0.0%	
AM Peak		09:00	08:00	08:00	09:00					05:00				09:00
Vol.		46	5	2	2					1				56
PM Peak		14:00	12:00	16:00	17:00									14:00
Vol.		42	6	3	1									48



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133213 B CLASS
Site Code: TBA

NB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
03/03/1														
3	0	2	2	0	0	0	0	0	0	0	0	0	0	4
01:00	0	0	0	0	1	0	0	0	0	0	0	0	0	1
02:00	0	1	0	0	1	0	0	0	0	0	0	0	0	2
03:00	0	3	0	0	0	0	0	0	0	0	0	0	0	3
04:00	0	3	2	0	0	0	0	0	0	0	0	0	0	5
05:00	0	11	4	0	0	0	0	0	0	0	0	0	0	15
06:00	0	11	5	0	0	0	0	0	1	0	0	0	0	17
07:00	0	19	4	0	1	0	0	0	0	1	0	0	0	25
08:00	0	14	5	0	0	0	0	0	0	0	0	0	0	19
09:00	0	19	5	0	1	0	0	0	0	0	0	0	0	25
10:00	0	21	0	0	0	0	0	0	0	0	0	0	0	21
11:00	0	17	7	0	0	0	0	0	0	0	0	0	0	24
12 PM	0	20	4	0	0	0	0	0	0	0	0	0	0	24
13:00	0	27	3	0	0	0	0	0	0	0	0	0	0	30
14:00	0	32	3	0	0	0	0	0	0	0	0	0	0	35
15:00	0	12	3	0	1	0	0	0	0	0	0	0	0	16
16:00	0	12	3	0	0	0	0	0	0	0	0	0	0	15
17:00	0	15	10	0	0	0	0	0	0	0	0	0	0	25
18:00	0	13	1	0	0	0	0	0	0	0	0	0	0	14
19:00	0	18	5	1	1	0	0	0	0	0	0	0	0	25
20:00	0	7	1	0	0	0	0	0	0	0	0	0	0	8
21:00	0	7	2	0	1	0	0	0	0	0	0	0	0	10
22:00	0	4	0	0	0	0	0	0	0	0	0	0	0	4
23:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
Total	0	290	69	1	7	0	0	0	1	1	0	0	0	369
Percent	0.0%	78.6%	18.7%	0.3%	1.9%	0.0%	0.0%	0.0%	0.3%	0.3%	0.0%	0.0%	0.0%	
AM Peak		10:00	11:00		01:00				06:00	07:00				07:00
Vol.		21	7		1				1	1				25
PM Peak		14:00	17:00	19:00	15:00									14:00
Vol.		32	10	1	1									35



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133213 B CLASS
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NB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
03/04/1														
3	0	2	1	0	0	0	0	0	0	0	0	0	0	3
01:00	0	1	1	0	0	0	0	0	0	0	0	0	0	2
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	3	0	0	0	0	0	0	0	0	0	0	0	3
04:00	0	12	0	0	0	0	0	0	0	0	0	0	0	12
05:00	0	42	8	0	0	0	0	0	0	0	0	0	0	50
06:00	0	74	11	2	0	0	0	0	0	0	0	0	0	87
07:00	0	118	22	2	2	1	0	0	1	0	0	0	0	146
08:00	0	55	11	2	3	0	0	0	0	0	0	0	0	71
09:00	0	65	12	1	3	0	0	1	0	0	0	0	0	82
10:00	0	52	10	1	4	2	0	0	0	2	0	0	0	71
11:00	0	50	10	1	3	1	0	0	0	0	0	0	0	65
12 PM	0	64	16	1	2	2	0	0	0	0	0	0	0	85
13:00	0	60	7	2	2	0	0	0	0	0	0	0	0	71
14:00	0	75	9	1	0	0	0	0	0	0	0	0	0	85
15:00	0	48	5	1	0	0	0	0	0	0	0	0	0	54
16:00	0	31	4	2	2	0	0	0	0	0	0	0	0	39
17:00	0	22	3	2	1	0	0	0	0	0	0	0	0	28
18:00	0	14	6	2	0	0	0	0	0	0	0	0	0	22
19:00	0	7	3	1	0	0	0	0	0	0	0	0	0	11
20:00	0	7	1	0	0	0	0	0	0	0	0	0	0	8
21:00	0	5	5	1	1	0	0	0	0	0	0	0	0	12
22:00	0	2	2	0	0	0	0	0	0	0	0	0	0	4
23:00	0	3	0	0	0	0	0	0	0	0	0	0	0	3
Total	0	812	147	22	23	6	0	1	1	2	0	0	0	1014
Percent	0.0%	80.1%	14.5%	2.2%	2.3%	0.6%	0.0%	0.1%	0.1%	0.2%	0.0%	0.0%	0.0%	
AM Peak		07:00	07:00	06:00	10:00	10:00		09:00	07:00	10:00				07:00
Vol.		118	22	2	4	2		1	1	2				146
PM Peak		14:00	12:00	13:00	12:00	12:00								12:00
Vol.		75	16	2	2	2								85
Total		4426	821	138	109	15	0	14	4	16	0	0	0	5546



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133213 B CLASS
Site Code: TBA

SB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
02/26/1														
3	0	5	1	0	0	0	0	0	0	0	0	0	0	6
01:00	0	2	1	0	0	0	0	0	0	0	0	0	0	3
02:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
03:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
04:00	0	2	1	0	0	0	0	0	0	0	0	0	0	3
05:00	0	18	4	0	1	0	0	0	0	0	0	0	0	23
06:00	0	17	9	2	1	0	0	0	0	0	0	0	0	29
07:00	0	27	7	2	3	0	0	0	1	0	0	0	0	40
08:00	0	12	6	2	3	0	0	0	0	0	0	0	0	23
09:00	0	18	12	1	2	0	0	1	1	0	0	0	0	35
10:00	0	31	8	1	0	0	0	0	0	0	0	0	0	40
11:00	0	73	11	1	2	0	0	2	0	0	0	0	0	89
12 PM	0	45	11	1	0	0	0	1	1	0	0	0	0	59
13:00	0	49	7	3	1	0	0	1	0	0	0	0	0	61
14:00	0	59	14	0	0	1	0	0	0	0	0	0	0	74
15:00	0	155	14	2	1	0	0	0	0	0	0	0	0	172
16:00	0	61	13	2	1	0	0	0	0	0	0	0	0	77
17:00	0	67	6	2	0	0	0	0	0	0	0	0	0	75
18:00	0	42	5	2	1	0	0	0	0	0	0	0	0	50
19:00	0	32	5	1	0	0	0	0	0	0	0	0	0	38
20:00	0	18	3	0	0	0	0	0	0	0	0	0	0	21
21:00	0	17	4	0	0	0	0	0	0	0	0	0	0	21
22:00	0	10	1	1	0	0	0	0	0	0	0	0	0	12
23:00	0	15	1	0	0	0	0	0	0	0	0	0	0	16
Total	0	778	144	23	16	1	0	5	3	0	0	0	0	970
Percent	0.0%	80.2%	14.8%	2.4%	1.6%	0.1%	0.0%	0.5%	0.3%	0.0%	0.0%	0.0%	0.0%	
AM Peak		11:00	09:00	06:00	07:00			11:00	07:00					11:00
Vol.		73	12	2	3			2	1					89
PM Peak		15:00	14:00	13:00	13:00	14:00		12:00	12:00					15:00
Vol.		155	14	3	1	1		1	1					172



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SB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
02/27/1														
3	0	22	8	0	1	0	0	0	0	0	0	0	0	31
01:00	0	6	1	0	0	0	0	0	0	0	0	0	0	7
02:00	0	5	2	0	0	0	0	0	0	0	0	0	0	7
03:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
04:00	0	1	2	0	0	0	0	0	0	0	0	0	0	3
05:00	0	1	2	0	0	0	0	0	0	0	0	0	0	3
06:00	0	4	2	2	1	0	0	0	0	0	0	0	0	9
07:00	0	22	4	2	1	0	0	0	1	0	0	0	0	30
08:00	0	16	3	2	3	0	0	0	0	0	0	0	0	24
09:00	0	11	11	1	2	0	0	0	0	0	0	0	0	25
10:00	0	27	3	1	0	0	0	1	0	0	0	0	0	32
11:00	0	54	6	1	1	1	0	0	1	0	0	0	0	64
12 PM	0	34	8	1	2	0	0	0	0	0	0	0	0	45
13:00	0	28	10	1	0	0	0	1	0	1	0	0	0	41
14:00	1	61	11	0	1	0	0	0	0	1	0	0	0	75
15:00	0	140	16	1	1	0	0	0	0	0	0	0	0	158
16:00	0	62	13	2	0	0	0	0	0	0	0	0	0	77
17:00	0	52	10	2	0	0	0	0	0	0	0	0	0	64
18:00	0	45	17	2	1	0	0	0	0	0	0	0	0	65
19:00	0	31	7	1	0	0	0	0	0	0	0	0	0	39
20:00	0	16	4	0	0	0	0	0	0	0	0	0	0	20
21:00	0	13	5	0	0	0	0	0	0	0	0	0	0	18
22:00	0	7	4	1	0	0	0	0	0	0	0	0	0	12
23:00	0	17	2	0	0	0	0	0	0	0	0	0	0	19
Total	1	676	151	20	14	1	0	2	2	2	0	0	0	869
Percent	0.1%	77.8%	17.4%	2.3%	1.6%	0.1%	0.0%	0.2%	0.2%	0.2%	0.0%	0.0%	0.0%	
AM Peak		11:00	09:00	06:00	08:00	11:00		10:00	07:00					11:00
Vol.		54	11	2	3	1		1	1					64
PM Peak	14:00	15:00	18:00	16:00	12:00			13:00		13:00				15:00
Vol.	1	140	17	2	2			1		1				158



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink

133213 B CLASS
Site Code: TBA

SB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
02/28/1														
3	0	2	0	0	0	0	0	0	0	0	0	0	0	2
01:00	0	1	0	1	0	0	0	0	0	0	0	0	0	2
02:00	0	6	0	0	0	0	0	0	0	0	0	0	0	6
03:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
04:00	0	1	0	0	0	0	0	0	0	0	0	0	0	1
05:00	0	2	4	0	1	0	0	0	0	0	0	0	0	7
06:00	0	11	4	2	0	1	0	0	0	0	0	0	0	18
07:00	0	31	5	2	1	1	0	1	1	0	0	0	0	42
08:00	0	13	3	1	3	0	0	0	0	0	0	0	0	20
09:00	0	19	8	2	1	0	0	0	0	0	0	0	0	30
10:00	0	19	6	2	3	1	0	1	0	0	0	0	0	32
11:00	0	78	16	1	2	0	0	1	0	0	0	0	0	98
12 PM	0	31	14	2	2	0	0	0	0	0	0	0	0	49
13:00	0	40	4	2	2	1	0	0	0	0	0	0	0	49
14:00	0	70	13	1	1	0	0	0	0	0	0	0	0	85
15:00	0	150	30	1	3	0	0	0	1	0	0	0	0	185
16:00	0	79	22	2	2	0	0	0	0	0	0	0	0	105
17:00	0	60	8	2	0	0	0	1	0	0	0	0	0	71
18:00	0	47	6	2	1	0	0	0	0	0	0	0	0	56
19:00	0	24	6	1	1	0	0	0	0	0	0	0	0	32
20:00	0	34	2	0	1	0	0	0	0	0	0	0	0	37
21:00	0	19	5	0	0	0	0	0	0	0	0	0	0	24
22:00	0	13	6	1	0	0	0	0	0	0	0	0	0	20
23:00	0	20	3	0	0	0	0	0	0	0	0	0	0	23
Total	0	772	165	25	24	4	0	4	2	0	0	0	0	996
Percent	0.0%	77.5%	16.6%	2.5%	2.4%	0.4%	0.0%	0.4%	0.2%	0.0%	0.0%	0.0%	0.0%	
AM Peak		11:00	11:00	06:00	08:00	06:00		07:00	07:00					11:00
Vol.		78	16	2	3	1		1	1					98
PM Peak		15:00	15:00	12:00	15:00	13:00		17:00	15:00					15:00
Vol.		150	30	2	3	1		1	1					185



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133213 B CLASS
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SB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
03/01/1														
3	0	9	0	1	0	0	0	0	0	0	0	0	0	10
01:00	0	11	2	0	0	0	0	0	0	0	0	0	0	13
02:00	0	2	2	0	0	0	0	0	0	0	0	0	0	4
03:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
04:00	0	1	1	0	0	0	0	0	0	0	0	0	0	2
05:00	0	3	2	0	0	0	0	0	0	0	0	0	0	5
06:00	0	6	3	2	1	0	0	0	0	0	0	0	0	12
07:00	0	24	7	2	1	0	0	0	0	0	0	0	0	34
08:00	0	10	2	2	2	0	0	0	0	0	0	0	0	16
09:00	0	23	10	1	2	0	0	1	0	0	0	0	0	37
10:00	0	36	10	2	2	0	0	1	0	0	0	0	0	51
11:00	0	73	14	1	4	0	0	1	0	0	0	0	0	93
12 PM	0	43	14	1	1	0	0	0	1	0	0	0	0	60
13:00	0	36	15	1	2	0	0	0	1	0	0	0	0	55
14:00	0	64	12	1	0	1	0	0	0	0	0	0	0	78
15:00	0	134	17	1	2	0	0	1	0	0	0	0	0	155
16:00	0	58	16	2	0	0	0	0	0	0	0	0	0	76
17:00	0	53	8	2	0	0	0	0	0	0	0	0	0	63
18:00	0	23	6	2	2	0	0	0	0	0	0	0	0	33
19:00	0	20	4	1	1	0	0	0	0	0	0	0	0	26
20:00	0	12	3	0	0	0	0	0	0	0	0	0	0	15
21:00	0	16	0	0	0	0	0	0	0	0	0	0	0	16
22:00	0	13	1	1	0	0	0	0	0	0	0	0	0	15
23:00	0	16	0	0	0	0	0	0	0	0	0	0	0	16
Total	0	688	149	23	20	1	0	4	2	0	0	0	0	887
Percent	0.0%	77.6%	16.8%	2.6%	2.3%	0.1%	0.0%	0.5%	0.2%	0.0%	0.0%	0.0%	0.0%	
AM Peak		11:00	11:00	06:00	11:00			09:00						11:00
Vol.		73	14	2	4			1						93
PM Peak		15:00	15:00	16:00	13:00	14:00		15:00	12:00					15:00
Vol.		134	17	2	2	1		1	1					155



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133213 B CLASS
Site Code: TBA

SB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
03/02/1														
3	0	12	1	0	0	0	0	0	0	0	0	0	0	13
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	0	3	0	0	0	0	0	0	0	0	0	0	0	3
03:00	0	0	1	0	0	0	0	0	0	0	0	0	0	1
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00	0	1	1	0	0	0	0	0	0	0	0	0	0	2
06:00	0	7	3	0	0	0	0	0	0	0	0	0	0	10
07:00	0	6	2	1	0	0	0	0	1	0	0	0	0	10
08:00	0	6	3	2	0	0	0	0	0	1	0	0	0	12
09:00	0	14	3	2	2	0	0	0	0	0	0	0	0	21
10:00	0	22	3	2	0	0	0	0	2	0	0	0	0	29
11:00	0	28	4	1	1	0	0	0	0	0	0	0	0	34
12 PM	0	41	6	1	0	0	0	0	0	0	0	0	0	48
13:00	0	19	4	2	0	0	0	0	0	0	0	0	0	25
14:00	0	54	8	2	0	0	0	0	0	0	0	0	0	64
15:00	0	34	5	2	2	0	0	0	0	0	0	0	0	43
16:00	0	29	6	2	0	0	0	0	0	0	0	0	0	37
17:00	1	28	4	3	2	0	0	0	0	0	0	0	0	38
18:00	0	16	8	2	1	0	0	0	0	0	0	0	0	27
19:00	0	17	8	2	2	0	0	0	0	0	0	0	0	29
20:00	0	9	3	1	0	0	0	0	0	0	0	0	0	13
21:00	0	5	2	0	0	0	0	0	0	0	0	0	0	7
22:00	0	5	4	0	0	0	0	0	0	0	0	0	0	9
23:00	0	18	1	0	0	0	0	0	0	0	0	0	0	19
Total	1	374	80	25	10	0	0	0	3	1	0	0	0	494
Percent	0.2%	75.7%	16.2%	5.1%	2.0%	0.0%	0.0%	0.0%	0.6%	0.2%	0.0%	0.0%	0.0%	
AM Peak		11:00	11:00	08:00	09:00				10:00	08:00				11:00
Vol.		28	4	2	2				2	1				34
PM Peak	17:00	14:00	14:00	17:00	15:00									14:00
Vol.	1	54	8	3	2									64



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133213 B CLASS
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SB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
03/03/1														
3	0	4	0	0	0	0	0	0	0	0	0	0	0	4
01:00	0	2	1	0	0	0	0	0	0	0	0	0	0	3
02:00	0	1	3	0	0	0	0	0	0	0	0	0	0	4
03:00	0	0	1	0	0	0	0	0	0	0	0	0	0	1
04:00	0	2	2	0	0	0	0	0	0	0	0	0	0	4
05:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
06:00	0	3	2	0	0	0	0	0	0	0	0	0	0	5
07:00	0	4	3	0	1	0	0	0	1	0	0	0	0	9
08:00	0	9	2	0	1	0	0	0	1	0	0	0	0	13
09:00	0	6	2	0	0	0	0	0	0	0	0	0	0	8
10:00	0	20	0	0	0	0	0	0	0	0	0	0	0	20
11:00	0	19	3	0	0	0	0	0	0	0	0	0	0	22
12 PM	0	17	4	0	0	0	0	0	0	0	0	0	0	21
13:00	0	11	3	0	0	0	0	0	0	0	0	0	0	14
14:00	0	37	11	0	1	0	0	0	0	0	0	0	0	49
15:00	0	31	4	0	0	0	0	0	0	0	0	0	0	35
16:00	0	25	4	0	0	0	0	0	0	0	0	0	0	29
17:00	0	24	7	0	1	0	0	0	0	0	0	0	0	32
18:00	0	22	8	0	0	0	0	0	0	0	0	0	0	30
19:00	0	28	7	1	0	0	0	0	0	0	0	0	0	36
20:00	0	13	5	0	0	0	0	0	0	0	0	0	0	18
21:00	0	13	3	0	0	0	0	0	0	0	0	0	0	16
22:00	0	11	2	0	0	0	0	0	0	0	0	0	0	13
23:00	0	10	2	0	0	0	0	0	0	0	0	0	0	12
Total	0	314	79	1	4	0	0	0	2	0	0	0	0	400
Percent	0.0%	78.5%	19.8%	0.3%	1.0%	0.0%	0.0%	0.0%	0.5%	0.0%	0.0%	0.0%	0.0%	
AM Peak		10:00	02:00		07:00				07:00					11:00
Vol.		20	3		1				1					22
PM Peak		14:00	14:00	19:00	14:00									14:00
Vol.		37	11	1	1									49



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133213 B CLASS
Site Code: TBA

SB

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total
03/04/1														
3	0	3	0	0	0	0	0	0	0	0	0	0	0	3
01:00	0	5	1	0	0	0	0	0	0	0	0	0	0	6
02:00	0	2	0	0	0	0	0	0	0	0	0	0	0	2
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	5	1	0	0	0	0	0	0	0	0	0	0	6
05:00	0	6	3	0	0	0	0	0	0	0	0	0	0	9
06:00	0	9	1	2	1	0	0	0	0	0	0	0	0	13
07:00	0	36	7	1	1	1	0	0	0	0	0	0	0	46
08:00	0	10	7	2	4	1	0	0	0	0	0	0	0	24
09:00	0	17	5	1	2	0	0	1	0	0	0	0	0	26
10:00	0	29	12	1	6	0	0	0	0	0	0	0	0	48
11:00	0	59	11	1	2	1	0	0	1	0	0	0	0	75
12 PM	0	41	12	1	1	2	0	0	1	0	0	0	0	58
13:00	0	43	9	1	2	1	0	0	1	0	0	0	0	57
14:00	0	53	9	2	2	0	0	0	0	0	0	0	0	66
15:00	0	151	17	1	0	0	0	0	0	0	0	0	0	169
16:00	0	68	8	2	0	0	0	0	0	0	0	0	0	78
17:00	0	55	14	3	1	0	0	0	0	0	0	0	0	73
18:00	0	47	9	2	1	0	0	0	0	0	0	0	0	59
19:00	0	26	7	1	0	0	0	0	0	0	0	0	0	34
20:00	0	21	6	0	0	0	0	0	0	0	0	0	0	27
21:00	0	14	3	0	1	0	0	0	0	0	0	0	0	18
22:00	0	4	2	1	0	0	0	0	0	0	0	0	0	7
23:00	0	14	5	0	0	0	0	0	0	0	0	0	0	19
Total	0	718	149	22	24	6	0	1	3	0	0	0	0	923
Percent	0.0%	77.8%	16.1%	2.4%	2.6%	0.7%	0.0%	0.1%	0.3%	0.0%	0.0%	0.0%	0.0%	
AM Peak		11:00	10:00	06:00	10:00	07:00		09:00	11:00					11:00
Vol.		59	12	2	6	1		1	1					75
PM Peak		15:00	15:00	17:00	13:00	12:00			12:00					15:00
Vol.		151	17	3	2	2			1					169
Total		4320	917	139	112	13	0	16	17	3	0	0	0	5539



PRECISION
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133213 B SPEED
Site Code: TBA

Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink

NB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
02/26/1																												
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
01:00	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	*	27
02:00	0	0	0	0	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3	*	34
03:00	0	0	0	0	0	3	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	5	31	36
04:00	0	0	0	0	0	0	4	3	3	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	10	45	42
05:00	0	0	2	1	11	9	5	2	1	0	0	5	2	1	0	0	0	0	0	0	0	0	0	0	0	31	41	36
06:00	0	0	1	7	29	39	19	3	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	100	41	36
07:00	0	1	1	0	45	57	39	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	151	42	37
08:00	0	1	2	4	28	33	8	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	79	39	35
09:00	0	2	2	13	28	21	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	77	39	33
10:00	0	2	4	4	19	29	6	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	65	38	34
11:00	0	1	1	11	34	26	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	82	38	34
12 PM	0	0	1	9	19	30	10	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	70	39	35
13:00	0	0	1	9	19	24	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	61	39	34
14:00	0	0	0	2	21	20	10	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	56	41	36
15:00	0	0	2	5	24	23	6	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	63	39	35
16:00	0	0	1	3	4	10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	38	34
17:00	0	0	0	6	6	13	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	38	34
18:00	0	0	0	2	9	7	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	40	35
19:00	0	1	0	1	4	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	34	32
20:00	0	0	0	0	5	1	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	42	38
21:00	0	0	0	0	2	2	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	7	*	41
22:00	0	0	0	0	3	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	33	36
23:00	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	*	34

%	0.0%	0.8%	1.9%	8.2%	32.7%	36.7%	15.9%	2.7%	0.8%	0.2%	0.0%	0.0%	0.0%															
AM Peak Vol.	09:00	05:00	09:00	07:00	07:00	07:00	07:00	07:00	07:00	06:00																07:00		
	2	2	13	45	57	39	6	2	1																	151		
Midday Peak Vol.	11:00	11:00	11:00	11:00	12:00	12:00	14:00	12:00																		11:00		
	1	1	11	34	30	10	3	1																		82		
PM Peak Vol.	19:00	15:00	17:00	15:00	15:00	15:00	15:00	15:00	21:00																	15:00		
	1	2	6	24	23	6	2	1	1																	63		
% ile			15th Percentile :		29 MPH																							
			50th Percentile :		34 MPH																							
			85th Percentile :		40 MPH																							
			95th Percentile :		44 MPH																							

Stats

10 MPH Pace Speed : 31-40 MPH

Number in Pace : 616

Percent in Pace : 64.0%

Number of Vehicles > 35 MPH : 468

Percent of Vehicles > 35 MPH : 48.6%

Mean Speed(Average) : 35 MPH



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

133213 B SPEED
Site Code: TBA

Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink

NB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
02/27/1																												
3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	*	37
01:00	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	*	37
02:00	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	*	44
03:00	0	0	0	0	0	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	*	37
04:00	0	0	0	0	0	2	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	38	38
05:00	0	1	0	1	2	8	10	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	43	38
06:00	0	0	0	3	24	32	11	3	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	78	43	37
07:00	0	0	2	4	34	50	23	8	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	123	41	37
08:00	0	1	1	8	26	24	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73	40	34
09:00	0	0	0	5	23	27	13	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	70	40	36
10:00	0	0	2	4	16	17	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46	39	35
11:00	1	0	0	6	17	18	13	2	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	59	41	36
12 PM	0	0	0	6	15	15	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46	41	36
13:00	0	0	1	9	23	17	7	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	59	39	34
14:00	0	0	0	5	15	24	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	53	39	36
15:00	0	0	0	3	15	26	7	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	53	39	36
16:00	0	0	0	5	13	8	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32	39	34
17:00	0	0	1	4	10	8	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	37	33
18:00	0	0	0	3	11	7	5	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	27	40	36
19:00	0	0	0	1	4	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	40	36
20:00	0	0	0	0	3	4	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	37	38
21:00	0	0	1	0	2	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	37	34
22:00	0	0	3	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	21	29
23:00	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	*	42

%	0.1%	0.2%	1.3%	8.1%	31.2%	36.7%	17.1%	3.8%	1.1%	0.1%	0.2%	0.0%	0.0%															
AM Peak Vol.		05:00	07:00	08:00	07:00	07:00	07:00	07:00	06:00	06:00																07:00		
		1	2	8	34	50	23	8	4	1																123		
Midday Peak Vol.	11:00		13:00	13:00	13:00	14:00	11:00	12:00	11:00		11:00															11:00		
	1		1	9	23	24	13	3	1		1															59		
PM Peak Vol.			22:00	16:00	15:00	15:00	15:00	15:00			18:00															15:00		
			3	5	15	26	7	2			1															53		
% ile			15th Percentile :			29 MPH																						
			50th Percentile :			35 MPH																						
			85th Percentile :			41 MPH																						
			95th Percentile :			44 MPH																						

Stats

10 MPH Pace Speed : 31-40 MPH

Number in Pace : 522

Percent in Pace : 63.3%

Number of Vehicles > 35 MPH : 424

Percent of Vehicles > 35 MPH : 51.4%

Mean Speed(Average) : 36 MPH



PRECISION
D A T A
INDUSTRIES, LLC

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133213 B SPEED
Site Code: TBA

Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink

NB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
02/28/1																												
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
02:00	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	*	32
03:00	0	0	0	0	0	1	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	*	42
04:00	0	0	0	0	0	2	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	42	38
05:00	0	0	4	3	10	13	6	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39	40	35
06:00	0	0	0	5	30	35	17	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	90	40	36
07:00	0	0	0	7	37	63	39	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	153	41	37
08:00	0	2	1	5	15	36	21	5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	86	42	37
09:00	0	0	0	5	24	26	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	67	39	35
10:00	0	0	1	9	20	15	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	52	39	34
11:00	1	0	2	7	26	28	14	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	79	40	34
12 PM	0	0	0	8	20	20	14	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64	40	36
13:00	0	0	0	2	17	28	12	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	40	36
14:00	0	2	0	7	20	31	11	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73	39	35
15:00	0	0	0	6	17	27	11	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	66	41	36
16:00	0	0	0	3	11	8	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	39	35
17:00	0	0	0	1	6	12	9	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	42	38
18:00	0	0	1	7	7	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	35	31
19:00	0	0	0	0	5	14	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	38	36
20:00	0	0	1	0	2	4	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	38	38
21:00	0	0	0	0	3	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	37	36
22:00	0	0	0	1	2	3	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	38	38
23:00	0	0	0	1	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	31	33

%	0.1%	0.4%	1.0%	7.9%	28.6%	38.2%	19.5%	3.4%	0.6%	0.2%	0.0%	0.0%	0.0%															
AM Peak		08:00	05:00	07:00	07:00	07:00	07:00	08:00	07:00	07:00																07:00		
Vol.		2	4	7	37	63	39	5	2	1																153		
Midday Peak	11:00	14:00	11:00	12:00	11:00	14:00	11:00	12:00																		11:00		
Vol.	1	2	2	8	26	31	14	2																		79		
PM Peak			18:00	18:00	15:00	15:00	15:00	15:00	17:00																	15:00		
Vol.			1	7	17	27	11	5	1																	66		
% ile			15th Percentile :			29 MPH																						
			50th Percentile :			35 MPH																						
			85th Percentile :			41 MPH																						
			95th Percentile :			44 MPH																						

Stats

10 MPH Pace Speed : 31-40 MPH

Number in Pace : 616

Percent in Pace : 63.2%

Number of Vehicles > 35 MPH : 523

Percent of Vehicles > 35 MPH : 53.7%

Mean Speed(Average) : 36 MPH



PRECISION
D A T A
INDUSTRIES, LLC

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133213 B SPEED
Site Code: TBA

Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink

NB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
03/01/1																												
3	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	*	39
01:00	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	*	30
02:00	0	0	0	0	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	*	42
03:00	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	*	42
04:00	0	0	0	0	2	4	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	33	36
05:00	0	0	0	0	2	9	13	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	39	36
06:00	0	0	0	0	3	30	36	12	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	84	39	36
07:00	0	1	3	12	37	50	21	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	135	41	36
08:00	0	0	1	2	33	38	15	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96	41	36
09:00	0	0	1	7	29	28	13	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	79	40	35
10:00	0	2	1	12	14	19	8	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	58	39	33
11:00	1	0	3	13	20	20	8	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	74	43	34
12 PM	0	0	2	12	17	25	9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	66	39	34
13:00	0	0	1	6	22	31	7	2	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73	40	36
14:00	0	0	0	5	15	21	4	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	48	39	36
15:00	0	0	0	5	23	10	8	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	41	35
16:00	0	0	1	2	8	10	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	41	36
17:00	0	0	1	2	9	9	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26	44	36
18:00	0	0	0	2	6	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	40	35
19:00	0	0	0	0	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	34	35
20:00	0	0	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	*	31
21:00	0	0	1	1	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	34	33
22:00	0	0	0	0	1	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	38	37
23:00	0	0	0	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	32	32

%	0.1%	0.3%	1.6%	10.0%	32.0%	35.9%	13.7%	5.3%	0.8%	0.2%	0.0%	0.0%	0.0%
AM Peak	07:00	07:00	07:00	07:00	07:00	07:00	07:00	07:00	06:00				07:00
Vol.	1	3	12	37	50	21	10	1					135
Midday Peak	11:00	11:00	11:00	13:00	13:00	12:00	11:00	13:00	13:00				11:00
Vol.	1	3	13	22	31	9	8	3	1				74
PM Peak		16:00	15:00	15:00	15:00	15:00	15:00						15:00
Vol.		1	5	23	10	8	4						50
% ile		15th Percentile :		29 MPH									
		50th Percentile :		34 MPH									
		85th Percentile :		40 MPH									
		95th Percentile :		45 MPH									

Stats

10 MPH Pace Speed :	30-39 MPH
Number in Pace :	572
Percent in Pace :	62.4%
Number of Vehicles > 35 MPH :	445
Percent of Vehicles > 35 MPH :	48.5%
Mean Speed(Average) :	35 MPH



PRECISION
D A T A
INDUSTRIES, LLC

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133213 B SPEED
Site Code: TBA

Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink

NB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
03/02/1																
3	0	0	0	0	0	2	1	0	0	0	0	0	0	3	*	39
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
03:00	0	0	0	0	2	1	1	0	0	0	0	0	0	4	*	36
04:00	0	0	0	0	2	1	0	0	0	0	0	0	0	3	*	34
05:00	0	1	0	0	1	9	2	0	0	0	0	0	0	13	39	35
06:00	0	0	0	2	8	10	5	2	0	0	0	0	0	27	41	36
07:00	0	0	1	5	12	14	5	2	0	0	0	0	0	39	40	35
08:00	0	0	0	2	6	14	10	1	0	0	0	0	0	33	42	37
09:00	1	2	1	3	19	22	7	1	0	0	0	0	0	56	39	33
10:00	0	0	0	7	8	15	5	2	0	0	0	0	0	37	40	35
11:00	0	0	0	7	13	16	3	1	1	0	0	0	0	41	38	35
12 PM	0	0	2	5	12	15	8	4	0	0	0	0	0	46	41	36
13:00	0	0	0	7	8	11	4	1	0	0	0	0	0	31	39	34
14:00	0	0	1	5	17	21	4	0	0	0	0	0	0	48	38	34
15:00	0	0	0	4	6	3	3	2	1	0	0	0	0	19	41	36
16:00	0	0	1	4	5	8	4	2	0	0	0	0	0	24	41	35
17:00	0	0	0	4	8	7	0	0	0	0	0	0	0	19	37	33
18:00	0	0	0	1	6	2	1	0	0	0	0	0	0	10	34	34
19:00	0	1	0	1	5	3	1	0	0	0	0	0	0	11	35	32
20:00	0	0	0	1	1	4	1	0	0	0	0	0	0	7	38	36
21:00	0	0	0	0	2	2	1	0	0	0	0	0	0	5	*	36
22:00	0	0	0	0	3	2	1	0	0	0	0	0	0	6	33	35
23:00	0	0	0	0	2	0	1	0	0	0	0	0	0	3	*	35

%	0.2%	0.8%	1.2%	12.0%	30.1%	37.5%	14.0%	3.7%	0.4%	0.0%	0.0%	0.0%	0.0%															
AM Peak Vol.	09:00	09:00	07:00	07:00	09:00	09:00	08:00	06:00																		09:00		
	1	2	1	5	19	22	10	2																		56		
Midday Peak Vol.			12:00	11:00	14:00	14:00	12:00	12:00	11:00																	14:00		
			2	7	17	21	8	4	1																	48		
PM Peak Vol.		19:00	16:00	15:00	17:00	16:00	16:00	15:00	15:00																	16:00		
		1	1	4	8	8	4	2	1																	24		
% ile			15th Percentile :			28 MPH																						
			50th Percentile :			34 MPH																						
			85th Percentile :			40 MPH																						
			95th Percentile :			44 MPH																						

Stats

10 MPH Pace Speed : 31-40 MPH

Number in Pace : 303

Percent in Pace : 62.5%

Number of Vehicles > 35 MPH : 231

Percent of Vehicles > 35 MPH : 47.6%

Mean Speed(Average) : 35 MPH



PRECISION
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north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink

NB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
03/03/1																												
3	0	0	0	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	*	37
01:00	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	*	37
02:00	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	*	39
03:00	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	*	39
04:00	0	0	0	0	0	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	37	37
05:00	0	0	0	0	0	4	3	5	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	42	40
06:00	0	0	0	0	2	4	9	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	37	36
07:00	0	0	0	0	1	6	8	4	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	45	39
08:00	0	0	0	0	2	5	6	3	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	41	38
09:00	0	0	0	0	1	10	8	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	41	36
10:00	0	0	0	0	4	5	9	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	38	35
11:00	0	0	0	0	2	12	7	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	38	34
12 PM	0	0	0	0	2	12	6	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	39	35
13:00	0	0	0	0	1	11	12	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	40	36
14:00	0	0	0	0	4	9	13	7	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	41	36
15:00	0	0	0	0	3	5	3	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	39	36
16:00	0	0	0	1	3	4	5	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	36	34
17:00	0	0	0	0	5	11	7	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	36	34
18:00	0	0	0	0	2	7	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	37	33
19:00	0	0	0	0	2	8	6	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	44	37
20:00	0	0	0	0	1	6	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	33	34
21:00	0	0	0	1	0	2	5	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	38	37
22:00	0	0	0	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	*	31
23:00	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	*	32

%	0.0%	0.0%	0.8%	10.0%	33.6%	33.1%	14.1%	5.7%	1.9%	0.8%	0.0%	0.0%	0.0%															
AM Peak Vol.				06:00	09:00	06:00	05:00	07:00	05:00	07:00																07:00		
				2	10	9	5	4	2	1																25		
Midday Peak Vol.				14:00	11:00	14:00	14:00	14:00																		14:00		
				4	12	13	7	2																		35		
PM Peak Vol.				16:00	17:00	17:00	17:00	19:00	19:00	15:00																17:00		
				1	5	11	7	5	4	2																25		
% ile				15th Percentile :			29 MPH																					
				50th Percentile :			34 MPH																					
				85th Percentile :			41 MPH																					
				95th Percentile :			46 MPH																					

Stats

10 MPH Pace Speed :	30-39 MPH
Number in Pace :	227
Percent in Pace :	61.5%
Number of Vehicles > 35 MPH :	181
Percent of Vehicles > 35 MPH :	49.0%
Mean Speed(Average) :	36 MPH



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

133213 B SPEED
Site Code: TBA

Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink

NB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
03/04/1																
3	0	0	0	1	2	0	0	0	0	0	0	0	0	3	*	30
01:00	0	0	0	0	0	2	0	0	0	0	0	0	0	2	*	37
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
03:00	0	0	0	1	1	0	1	0	0	0	0	0	0	3	*	34
04:00	0	0	0	1	2	7	2	0	0	0	0	0	0	12	39	36
05:00	0	0	0	2	15	21	7	4	0	0	0	0	1	50	41	37
06:00	0	0	0	7	24	38	16	1	1	0	0	0	0	87	40	36
07:00	0	0	5	5	36	60	28	10	2	0	0	0	0	146	42	37
08:00	1	0	0	4	21	32	9	3	0	1	0	0	0	71	40	36
09:00	0	0	1	10	31	25	13	2	0	0	0	0	0	82	39	35
10:00	0	0	3	5	24	30	7	2	0	0	0	0	0	71	38	35
11:00	0	1	2	6	24	28	3	1	0	0	0	0	0	65	38	34
12 PM	0	1	0	8	34	30	11	1	0	0	0	0	0	85	39	34
13:00	0	0	1	6	21	25	13	3	0	1	1	0	0	71	40	36
14:00	0	0	1	12	20	31	12	9	0	0	0	0	0	85	42	36
15:00	0	0	2	8	15	23	6	0	0	0	0	0	0	54	39	34
16:00	0	0	0	7	16	12	2	1	1	0	0	0	0	39	37	34
17:00	0	0	1	1	11	10	4	1	0	0	0	0	0	28	40	35
18:00	0	0	0	1	14	5	1	0	1	0	0	0	0	22	37	34
19:00	0	0	0	0	6	3	2	0	0	0	0	0	0	11	37	35
20:00	0	0	0	2	2	3	1	0	0	0	0	0	0	8	37	34
21:00	0	0	1	1	7	3	0	0	0	0	0	0	0	12	35	32
22:00	0	0	0	0	3	1	0	0	0	0	0	0	0	4	32	33
23:00	0	0	0	1	1	1	0	0	0	0	0	0	0	3	*	32

%	0.1%	0.2%	1.7%	8.8%	32.5%	38.5%	13.6%	3.7%	0.5%	0.2%	0.1%	0.0%	0.1%															
AM Peak Vol.	08:00		07:00	09:00	07:00	07:00	07:00	07:00	07:00	08:00				05:00	07:00													
	1		5	10	36	60	28	10	2	1				1	146													
Midday Peak Vol.		11:00	11:00	14:00	12:00	14:00	13:00	14:00		13:00	13:00				12:00													
		1	2	12	34	31	13	9		1	1				85													
PM Peak Vol.			15:00	15:00	16:00	15:00	15:00	16:00	16:00						15:00													
			2	8	16	23	6	1	1						54													
% ile			15th Percentile :		29 MPH																							
			50th Percentile :		34 MPH																							
			85th Percentile :		40 MPH																							
			95th Percentile :		44 MPH																							

Stats

10 MPH Pace Speed : 31-40 MPH

Number in Pace : 661

Percent in Pace : 65.3%

Number of Vehicles > 35 MPH : 493

Percent of Vehicles > 35 MPH : 48.6%

Mean Speed(Average) : 35 MPH



PRECISION
D A T A
INDUSTRIES, LLC

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133213 B SPEED
Site Code: TBA

Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink

SB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
02/26/1																												
3	0	0	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	36	34
01:00	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	*	35
02:00	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	*	27
03:00	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	*	34
04:00	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	*	34
05:00	0	0	0	0	2	3	7	8	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	43	39
06:00	0	0	1	5	9	8	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	39	34
07:00	1	0	0	8	17	8	4	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	40	38	33
08:00	0	0	0	9	7	5	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	36	33
09:00	0	0	6	6	11	8	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	37	32
10:00	0	0	1	7	14	14	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	38	34
11:00	0	0	3	16	24	27	13	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	89	41	35
12 PM	0	0	0	13	24	18	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	59	36	33
13:00	0	3	2	13	16	22	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	61	37	32
14:00	1	0	1	6	18	26	16	5	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	74	42	36
15:00	0	1	3	22	67	51	21	5	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	172	39	34
16:00	0	0	1	11	33	19	11	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	77	39	34
17:00	0	0	2	13	24	25	7	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	75	38	35
18:00	0	0	1	3	12	24	7	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	40	36
19:00	0	2	0	4	11	14	5	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	38	40	34
20:00	0	0	0	3	5	5	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	42	37
21:00	0	0	0	3	5	9	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	40	36
22:00	0	0	0	0	2	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	42	38
23:00	0	0	1	0	4	9	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	38	35

%	0.2%	0.6%	2.3%	15.1%	32.1%	32.2%	13.1%	3.2%	0.6%	0.2%	0.4%	0.1%	0.0%															
AM Peak Vol.	07:00		09:00	08:00	07:00	06:00	05:00	05:00	08:00		07:00	09:00		07:00														
	1		6	9	17	8	8	3	2		1	1		40														
Midday Peak Vol.	14:00	13:00	11:00	11:00	11:00	11:00	14:00	11:00	11:00		14:00		11:00															
	1	3	3	16	24	27	16	5	1		1		89															
PM Peak Vol.		19:00	15:00	15:00	15:00	15:00	15:00	15:00	15:00	15:00	15:00	17:00		15:00														
		2	3	22	67	51	21	5	1	1	1		172															
% ile			15th Percentile :				27 MPH																					
			50th Percentile :				33 MPH																					
			85th Percentile :				40 MPH																					
			95th Percentile :				44 MPH																					

Stats

10 MPH Pace Speed : 30-39 MPH

Number in Pace : 579

Percent in Pace : 59.7%

Number of Vehicles > 35 MPH : 418

Percent of Vehicles > 35 MPH : 43.1%

Mean Speed(Average) : 34 MPH



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

133213 B SPEED
Site Code: TBA

Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink

SB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
02/27/1																
3	0	0	0	0	2	10	15	1	3	0	0	0	0	31	43	41
01:00	0	0	0	1	3	2	1	0	0	0	0	0	0	7	33	34
02:00	0	0	0	0	2	1	3	1	0	0	0	0	0	7	42	39
03:00	0	0	0	1	0	0	0	0	0	0	0	0	0	1	*	27
04:00	0	0	0	1	0	2	0	0	0	0	0	0	0	3	*	34
05:00	0	0	0	1	0	1	0	1	0	0	0	0	0	3	*	37
06:00	0	0	0	1	5	2	0	1	0	0	0	0	0	9	34	34
07:00	0	0	0	4	11	9	1	4	1	0	0	0	0	30	44	36
08:00	0	0	0	10	8	5	1	0	0	0	0	0	0	24	36	31
09:00	0	0	0	4	10	9	1	1	0	0	0	0	0	25	37	34
10:00	0	0	2	3	15	7	2	3	0	0	0	0	0	32	39	34
11:00	0	0	3	12	21	14	12	2	0	0	0	0	0	64	40	34
12 PM	0	0	2	7	16	14	5	1	0	0	0	0	0	45	39	34
13:00	0	1	1	6	10	13	10	0	0	0	0	0	0	41	41	34
14:00	1	0	0	9	19	30	14	2	0	0	0	0	0	75	40	35
15:00	0	1	7	17	57	52	18	5	1	0	0	0	0	158	39	34
16:00	0	0	0	13	28	22	11	3	0	0	0	0	0	77	40	35
17:00	0	0	2	6	22	20	13	1	0	0	0	0	0	64	40	35
18:00	0	0	1	15	17	18	11	3	0	0	0	0	0	65	40	34
19:00	0	0	1	4	13	16	4	0	0	0	1	0	0	39	38	35
20:00	0	0	0	3	6	9	2	0	0	0	0	0	0	20	38	34
21:00	0	1	0	3	3	9	2	0	0	0	0	0	0	18	38	33
22:00	0	0	1	0	2	5	4	0	0	0	0	0	0	12	41	37
23:00	0	0	0	3	5	10	0	1	0	0	0	0	0	19	37	35

%	0.1%	0.3%	2.3%	14.3%	31.6%	32.2%	15.0%	3.5%	0.6%	0.0%	0.1%	0.0%	0.0%			
AM Peak Vol.				08:00	07:00	00:00	00:00	07:00	00:00					00:00		
				10	11	10	15	4	3					31		
Midday Peak Vol.	14:00	13:00	11:00	11:00	11:00	14:00	14:00	11:00						14:00		
	1	1	3	12	21	30	14	2						75		
PM Peak Vol.		15:00	15:00	15:00	15:00	15:00	15:00	15:00	15:00		19:00			15:00		
		1	7	17	57	52	18	5	1		1			158		
% ile			15th Percentile :			28 MPH										
			50th Percentile :			34 MPH										
			85th Percentile :			40 MPH										
			95th Percentile :			44 MPH										

Stats

10 MPH Pace Speed :	30-39 MPH
Number in Pace :	518
Percent in Pace :	59.6%
Number of Vehicles > 35 MPH :	389
Percent of Vehicles > 35 MPH :	44.7%
Mean Speed(Average) :	35 MPH



PRECISION
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133213 B SPEED
Site Code: TBA

Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink

SB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
02/28/1																												
3	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	*	37
01:00	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	*	32
02:00	0	0	0	0	0	1	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	38	38
03:00	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	*	42
04:00	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	*	27
05:00	0	0	0	0	0	0	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	39	40
06:00	0	0	1	2	9	3	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	36	34
07:00	0	0	1	3	20	12	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42	39	34
08:00	0	0	0	1	10	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	40	35
09:00	0	0	0	4	8	8	7	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	30	40	38
10:00	0	1	0	7	10	8	4	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32	38	34
11:00	0	0	1	8	26	38	21	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	98	41	36
12 PM	0	0	1	5	10	21	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	49	40	36
13:00	0	0	2	5	10	19	8	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	49	41	36
14:00	0	0	0	7	21	28	23	5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	85	42	37
15:00	0	0	2	7	57	76	36	5	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	185	40	36
16:00	0	0	1	9	31	43	18	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	105	40	36
17:00	0	0	0	7	15	28	15	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	71	42	37
18:00	0	0	1	2	20	22	8	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	56	40	36
19:00	0	0	0	2	14	10	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32	40	35
20:00	0	0	0	3	8	18	7	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	37	40	36
21:00	0	0	0	1	8	8	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	41	37
22:00	0	0	1	1	5	9	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	40	36
23:00	0	0	0	0	5	15	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	39	37

%	0.0%	0.1%	1.1%	7.5%	29.1%	38.3%	19.4%	3.1%	0.8%	0.4%	0.2%	0.0%	0.0%															
AM Peak Vol.			06:00	09:00	07:00	07:00	09:00	03:00	09:00	09:00	09:00															07:00		
			1	4	20	12	7	1	1	1	1															42		
Midday Peak Vol.			13:00	11:00	11:00	11:00	14:00	14:00	11:00	14:00																11:00		
			2	8	26	38	23	5	3	1																98		
PM Peak Vol.			15:00	16:00	15:00	15:00	15:00	17:00	16:00	15:00	15:00															15:00		
			2	9	57	76	36	6	1	1	1															185		
% ile			15th Percentile :			29 MPH																						
			50th Percentile :			35 MPH																						
			85th Percentile :			41 MPH																						
			95th Percentile :			44 MPH																						

Stats

10 MPH Pace Speed : 31-40 MPH

Number in Pace : 635

Percent in Pace : 63.8%

Number of Vehicles > 35 MPH : 539

Percent of Vehicles > 35 MPH : 54.1%

Mean Speed(Average) : 36 MPH



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
Office: 508.481.3999 Fax: 508.545.1234
Email: datarequests@pdillc.com

133213 B SPEED
Site Code: TBA

Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink

SB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
03/01/1																
3	0	0	0	1	2	4	1	1	1	0	0	0	0	10	38	38
01:00	0	0	0	0	5	5	3	0	0	0	0	0	0	13	40	36
02:00	0	0	0	0	0	3	1	0	0	0	0	0	0	4	37	38
03:00	0	0	0	0	0	1	0	1	0	0	0	0	0	2	*	42
04:00	0	0	0	0	1	1	0	0	0	0	0	0	0	2	*	34
05:00	0	0	0	0	3	1	1	0	0	0	0	0	0	5	32	35
06:00	0	0	0	3	6	2	1	0	0	0	0	0	0	12	34	32
07:00	0	1	2	1	13	12	4	1	0	0	0	0	0	34	39	34
08:00	0	0	0	4	5	3	3	1	0	0	0	0	0	16	40	34
09:00	0	0	0	5	8	14	8	1	0	0	1	0	0	37	40	37
10:00	0	0	0	7	16	21	6	1	0	0	0	0	0	51	39	35
11:00	0	0	1	4	32	35	15	4	0	1	1	0	0	93	40	36
12 PM	0	0	0	11	18	18	10	3	0	0	0	0	0	60	40	35
13:00	0	0	1	6	18	21	5	3	1	0	0	0	0	55	40	35
14:00	0	0	3	5	15	30	19	3	1	0	1	1	0	78	41	37
15:00	0	1	1	9	56	62	23	3	0	0	0	0	0	155	39	35
16:00	0	0	2	4	35	18	12	5	0	0	0	0	0	76	41	35
17:00	0	0	1	9	14	28	10	1	0	0	0	0	0	63	40	35
18:00	0	0	0	2	10	15	4	2	0	0	0	0	0	33	40	36
19:00	0	0	0	4	7	10	3	1	1	0	0	0	0	26	39	36
20:00	0	0	0	0	2	11	2	0	0	0	0	0	0	15	39	37
21:00	0	0	0	1	3	9	2	1	0	0	0	0	0	16	38	37
22:00	0	0	0	0	4	3	8	0	0	0	0	0	0	15	42	38
23:00	0	0	0	1	4	8	3	0	0	0	0	0	0	16	39	36

%	0.0%	0.2%	1.2%	8.7%	31.2%	37.8%	16.2%	3.6%	0.5%	0.1%	0.3%	0.1%	0.0%
AM Peak Vol.	07:00	07:00	09:00	07:00	09:00	09:00	00:00	00:00		09:00		09:00	
	1	2	5	13	14	8	1	1		1		37	
Midday Peak Vol.		14:00	12:00	11:00	11:00	14:00	11:00	13:00	11:00	11:00	14:00	11:00	
		3	11	32	35	19	4	1	1	1	1	93	
PM Peak Vol.	15:00	16:00	15:00	15:00	15:00	15:00	16:00	19:00				15:00	
	1	2	9	56	62	23	5	1				155	
% ile		15th Percentile :			29 MPH								
		50th Percentile :			35 MPH								
		85th Percentile :			40 MPH								
		95th Percentile :			44 MPH								

Stats

10 MPH Pace Speed : 31-40 MPH

Number in Pace : 569

Percent in Pace : 64.1%

Number of Vehicles > 35 MPH : 450

Percent of Vehicles > 35 MPH : 50.7%

Mean Speed(Average) : 36 MPH



PRECISION
D A T A
INDUSTRIES, LLC

P.O. Box 301 Berlin, MA 01503
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133213 B SPEED
Site Code: TBA

Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink

SB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
03/02/1																
3	0	0	0	1	4	6	2	0	0	0	0	0	0	13	39	35
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
02:00	0	0	0	0	0	1	1	1	0	0	0	0	0	3	*	42
03:00	0	0	0	0	1	0	0	0	0	0	0	0	0	1	*	32
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
05:00	0	0	0	0	0	2	0	0	0	0	0	0	0	2	*	37
06:00	0	0	0	1	3	4	2	0	0	0	0	0	0	10	38	36
07:00	0	0	0	0	3	3	3	1	0	0	0	0	0	10	41	38
08:00	0	0	0	2	3	4	2	1	0	0	0	0	0	12	38	36
09:00	0	0	1	3	4	10	3	0	0	0	0	0	0	21	38	35
10:00	1	0	0	1	8	16	1	2	0	0	0	0	0	29	38	34
11:00	0	0	2	2	10	10	9	1	0	0	0	0	0	34	41	36
12 PM	0	0	2	3	16	11	7	8	1	0	0	0	0	48	44	37
13:00	0	0	0	0	10	11	3	1	0	0	0	0	0	25	39	36
14:00	0	0	0	6	20	23	13	2	0	0	0	0	0	64	40	36
15:00	0	1	2	3	7	13	14	1	2	0	0	0	0	43	42	37
16:00	0	1	0	3	13	16	4	0	0	0	0	0	0	37	38	34
17:00	0	0	1	4	11	12	7	3	0	0	0	0	0	38	41	36
18:00	0	0	0	5	8	5	7	2	0	0	0	0	0	27	42	36
19:00	0	0	0	2	5	13	9	0	0	0	0	0	0	29	41	37
20:00	0	0	0	1	5	2	3	2	0	0	0	0	0	13	42	37
21:00	0	0	0	1	0	3	1	2	0	0	0	0	0	7	37	39
22:00	0	0	0	1	2	4	1	1	0	0	0	0	0	9	38	36
23:00	0	0	0	1	4	9	5	0	0	0	0	0	0	19	41	37

%	0.2%	0.4%	1.6%	8.1%	27.7%	36.0%	19.6%	5.7%	0.6%	0.0%	0.0%	0.0%	0.0%															
AM Peak Vol.			09:00	09:00	00:00	09:00	07:00	02:00																		09:00		
			1	3	4	10	3	1																		21		
Midday Peak Vol.			11:00	14:00	14:00	14:00	14:00	12:00	12:00																	14:00		
			2	6	20	23	13	8	1																	64		
PM Peak Vol.		15:00	15:00	18:00	16:00	16:00	15:00	17:00	15:00																	15:00		
		1	2	5	13	16	14	3	2																	43		
% ile			15th Percentile :			29 MPH																						
			50th Percentile :			35 MPH																						
			85th Percentile :			41 MPH																						
			95th Percentile :			45 MPH																						

Stats

10 MPH Pace Speed : 31-40 MPH

Number in Pace : 299

Percent in Pace : 60.5%

Number of Vehicles > 35 MPH : 268

Percent of Vehicles > 35 MPH : 54.2%

Mean Speed(Average) : 36 MPH



PRECISION
D A T A
INDUSTRIES, LLC

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133213 B SPEED
Site Code: TBA

Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink

SB

Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
03/03/1																												
3	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	36	36
01:00	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	*	29
02:00	0	0	0	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	*	37
03:00	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	*	32
04:00	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	*	39
05:00	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	*	37
06:00	0	0	0	0	1	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	*	35
07:00	0	0	1	1	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	33	34
08:00	0	0	0	3	3	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	37	35
09:00	0	0	0	0	1	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	39	39
10:00	0	0	1	3	8	5	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	37	34
11:00	0	0	0	4	6	5	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	42	35
12 PM	0	0	1	1	6	7	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	40	37
13:00	0	0	0	1	4	4	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	44	38
14:00	0	1	1	3	12	17	9	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	49	43	36
15:00	0	0	0	4	14	12	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	38	35
16:00	0	0	1	3	11	8	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	39	35
17:00	0	0	1	3	10	11	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32	40	35
18:00	0	0	0	6	7	14	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	38	34
19:00	0	0	0	2	10	17	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	41	36
20:00	0	0	0	4	8	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	36	33
21:00	0	0	0	4	3	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	39	35
22:00	0	0	0	1	4	3	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	41	37
23:00	0	0	0	1	6	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	34	35

%	0.0%	0.3%	1.8%	11.3%	30.5%	34.5%	15.3%	5.5%	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AM Peak Vol.			01:00	08:00	07:00	08:00	04:00	07:00																		08:00		
			1	3	3	4	2	1																		13		
Midday Peak Vol.		14:00	12:00	11:00	14:00	14:00	14:00	14:00	12:00																	14:00		
		1	1	4	12	17	9	5	2																	49		
PM Peak Vol.			16:00	18:00	15:00	19:00	17:00	19:00	16:00																	19:00		
			1	6	14	17	7	3	1																	36		
% ile			15th Percentile :			28 MPH																						
			50th Percentile :			34 MPH																						
			85th Percentile :			41 MPH																						
			95th Percentile :			45 MPH																						

Stats

10 MPH Pace Speed : 31-40 MPH

Number in Pace : 241

Percent in Pace : 60.3%

Number of Vehicles > 35 MPH : 197

Percent of Vehicles > 35 MPH : 49.1%

Mean Speed(Average) : 35 MPH



PRECISION
D A T A
INDUSTRIES, LLC

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133213 B SPEED
Site Code: TBA

Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink

SB

Start Time	1 14	15 19	20 24	25 29	30 34	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 9999	Total	85th % ile	Ave Speed
03/04/1																
3	0	0	0	1	1	0	0	1	0	0	0	0	0	3	*	35
01:00	0	0	0	1	4	1	0	0	0	0	0	0	0	6	33	32
02:00	0	0	0	0	0	1	1	0	0	0	0	0	0	2	*	39
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
04:00	0	0	0	0	3	1	2	0	0	0	0	0	0	6	32	36
05:00	0	0	0	1	2	5	1	0	0	0	0	0	0	9	38	35
06:00	0	0	0	5	4	1	2	1	0	0	0	0	0	13	32	33
07:00	0	0	1	6	16	13	6	4	0	0	0	0	0	46	41	35
08:00	0	0	0	3	14	3	0	3	0	1	0	0	0	24	35	35
09:00	0	0	0	5	13	7	1	0	0	0	0	0	0	26	36	33
10:00	0	0	1	8	16	18	3	2	0	0	0	0	0	48	38	34
11:00	0	0	4	8	22	30	9	2	0	0	0	0	0	75	39	35
12 PM	0	2	1	2	19	28	2	3	0	1	0	0	0	58	38	35
13:00	0	1	2	12	17	17	6	2	0	0	0	0	0	57	39	33
14:00	0	0	0	4	17	28	10	5	1	0	1	0	0	66	42	37
15:00	0	0	2	13	64	62	25	3	0	0	0	0	0	169	39	35
16:00	0	1	2	5	35	30	5	0	0	0	0	0	0	78	38	34
17:00	0	1	1	2	24	27	12	5	1	0	0	0	0	73	42	36
18:00	0	0	0	8	16	27	6	2	0	0	0	0	0	59	39	35
19:00	0	0	1	3	14	12	3	0	0	1	0	0	0	34	38	35
20:00	0	0	0	2	6	15	2	1	1	0	0	0	0	27	38	36
21:00	0	0	0	4	8	4	1	0	0	1	0	0	0	18	36	34
22:00	0	0	0	2	0	4	1	0	0	0	0	0	0	7	38	35
23:00	0	0	0	1	3	12	3	0	0	0	0	0	0	19	39	36

%	0.0%	0.5%	1.6%	10.4%	34.5%	37.5%	10.9%	3.7%	0.3%	0.4%	0.1%	0.0%	0.0%															
AM Peak Vol.			07:00	07:00	07:00	07:00	07:00	07:00		08:00																07:00		
			1	6	16	13	6	4		1																46		
Midday Peak Vol.		12:00	11:00	13:00	11:00	11:00	14:00	14:00	14:00	12:00	14:00															11:00		
		2	4	12	22	30	10	5	1	1	1															75		
PM Peak Vol.		16:00	15:00	15:00	15:00	15:00	15:00	17:00	17:00	19:00																15:00		
		1	2	13	64	62	25	5	1	1																169		
% ile			15th Percentile :			28 MPH																						
			50th Percentile :			34 MPH																						
			85th Percentile :			39 MPH																						
			95th Percentile :			44 MPH																						

Stats

10 MPH Pace Speed : 30-39 MPH

Number in Pace : 606

Percent in Pace : 65.7%

Number of Vehicles > 35 MPH : 418

Percent of Vehicles > 35 MPH : 45.2%

Mean Speed(Average) : 35 MPH

Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink



133213 B VOLUME
Site Code: TBA

Start		NB		SB		Combined		26-Feb-13 Tue	
Time	A.M.	P.M.		A.M.	P.M.	A.M.	P.M.		
12:00	0	21		0	19	0	40		
12:15	0	12		2	18	2	30		
12:30	0	15		1	11	1	26		
12:45	0	22	70	3	11	3	33	129	
01:00	0	15		0	15	0	30		
01:15	1	12		3	11	4	23		
01:30	0	13		0	15	0	28		
01:45	0	21	61	0	20	0	41	122	
02:00	0	14		0	20	0	34		
02:15	0	12		0	9	0	21		
02:30	2	14		0	28	2	42		
02:45	1	16	56	1	17	2	33	130	
03:00	1	36		1	105	2	141		
03:15	1	11		1	20	2	31		
03:30	1	7		0	27	1	34		
03:45	2	9	63	0	20	2	29	235	
04:00	2	6		2	24	4	30		
04:15	4	2		1	25	5	27		
04:30	2	8		0	12	2	20		
04:45	2	4	20	0	16	2	20	97	
05:00	3	8		1	19	4	27		
05:15	1	6		1	23	2	29		
05:30	10	8		2	16	12	24		
05:45	17	6	28	19	17	36	23	103	
06:00	14	6		13	17	27	23		
06:15	18	8		3	18	21	26		
06:30	23	5		6	8	29	13		
06:45	45	4	23	7	7	52	11	73	
07:00	47	1		11	7	58	8		
07:15	53	5		14	10	67	15		
07:30	34	1		9	7	43	8		
07:45	17	3	10	6	14	23	17	48	
08:00	15	4		3	12	18	16		
08:15	22	4		6	7	28	11		
08:30	21	0		6	2	27	2		
08:45	21	3	11	8	0	29	3	32	
09:00	21	2		8	9	29	11		
09:15	18	1		10	4	28	5		
09:30	16	1		9	4	25	5		
09:45	22	3	7	8	35	30	7	28	
10:00	20	1		12	7	32	8		
10:15	14	2		6	1	20	3		
10:30	17	2		8	3	25	5		
10:45	14	2	7	14	1	28	3	19	
11:00	18	0		13	7	31	7		
11:15	16	1		47	5	63	6		
11:30	17	0		15	3	32	3		
11:45	31	1	2	14	89	45	2	18	
Total	604	358		294	676	898	1034		
Percent	67.3%	34.6%		32.7%	65.4%				
Day Total		962		970		1932			
Peak	06:45	02:15		10:45	03:00	06:45	02:30		
Vol.	179	78		89	172	220	247		
P.H.F.	0.844	0.542		0.473	0.410	0.821	0.438		

Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink



PRECISION
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133213 B VOLUME
Site Code: TBA

Start	NB		SB		Combined		27-Feb-13 Wed
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
12:00	0	15	1	12	1	27	
12:15	0	11	0	11	0	22	
12:30	0	12	30	9	30	21	
12:45	1	8	0	13	1	21	91
01:00	1	17	2	9	3	26	
01:15	0	10	3	7	3	17	
01:30	0	16	2	9	2	25	
01:45	1	16	0	16	1	32	100
02:00	0	18	3	21	3	39	
02:15	1	16	3	14	4	30	
02:30	0	11	0	23	0	34	
02:45	1	8	1	17	2	25	128
03:00	1	23	0	107	1	130	
03:15	0	6	1	7	1	13	
03:30	2	1	0	23	2	24	
03:45	1	23	0	21	1	44	211
04:00	2	14	0	34	2	48	
04:15	0	6	2	18	2	24	
04:30	0	6	0	14	0	20	
04:45	6	6	1	11	7	17	109
05:00	0	6	1	18	1	24	
05:15	3	4	0	19	3	23	
05:30	5	7	0	13	5	20	
05:45	17	8	2	14	19	22	89
06:00	11	7	2	21	13	28	
06:15	19	8	3	16	22	24	
06:30	20	7	2	13	22	20	
06:45	28	5	2	15	30	20	92
07:00	41	3	9	7	50	10	
07:15	43	5	14	12	57	17	
07:30	26	2	6	3	32	5	
07:45	13	4	1	17	14	21	53
08:00	14	0	8	8	22	8	
08:15	23	4	4	4	27	8	
08:30	21	5	6	5	27	10	
08:45	15	1	6	3	21	4	30
09:00	16	1	4	6	20	7	
09:15	19	1	9	2	28	3	
09:30	17	4	10	6	27	10	
09:45	18	1	2	4	20	5	25
10:00	14	1	6	1	20	2	
10:15	11	2	8	1	19	3	
10:30	11	2	8	6	19	8	
10:45	10	0	10	4	20	4	17
11:00	5	1	6	11	11	12	
11:15	11	1	37	0	48	1	
11:30	16	0	12	5	28	5	
11:45	27	1	9	3	36	4	22
Total	491	334	236	633	727	967	
Percent	67.5%	34.5%	32.5%	65.5%			
Day Total	825		869		1694		
Peak	06:45	01:30	10:45	02:15	06:45	02:15	
Vol.	138	66	65	161	169	219	
P.H.F.	0.802	0.917	0.439	0.376	0.741	0.421	

Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink



133213 B VOLUME
Site Code: TBA

Start	NB		SB		Combined		28-Feb-13
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	Thu
12:00	0	16	2	8	2	24	
12:15	0	16	0	16	0	32	
12:30	0	12	0	13	0	25	
12:45	0	20	0	12	0	32	113
01:00	0	9	1	14	1	23	
01:15	0	14	1	13	1	27	
01:30	0	14	0	10	0	24	
01:45	0	23	0	12	0	35	109
02:00	1	21	1	19	2	40	
02:15	0	15	2	15	2	30	
02:30	0	18	3	35	3	53	
02:45	0	19	0	16	0	35	158
03:00	1	36	1	109	2	145	
03:15	1	14	0	24	1	38	
03:30	1	9	1	32	2	41	
03:45	1	7	0	20	1	27	251
04:00	1	9	1	42	2	51	
04:15	0	7	0	24	0	31	
04:30	1	10	0	24	1	34	
04:45	6	2	0	15	6	17	133
05:00	3	9	1	18	4	27	
05:15	2	6	2	18	4	24	
05:30	12	9	0	14	12	23	
05:45	22	7	4	21	26	28	102
06:00	10	2	1	15	11	17	
06:15	20	5	4	16	24	21	
06:30	26	4	2	10	28	14	
06:45	34	8	11	15	45	23	75
07:00	53	6	10	7	63	13	
07:15	57	5	12	7	69	12	
07:30	23	6	7	11	30	17	
07:45	20	4	13	7	33	11	53
08:00	14	3	4	11	18	14	
08:15	31	2	4	12	35	14	
08:30	18	4	7	9	25	13	
08:45	23	2	5	5	28	7	48
09:00	13	2	6	7	19	9	
09:15	19	2	8	4	27	6	
09:30	21	1	4	4	25	5	
09:45	14	3	12	9	26	12	32
10:00	19	4	8	5	27	9	
10:15	11	1	11	4	22	5	
10:30	9	2	6	5	15	7	
10:45	13	2	7	6	20	8	29
11:00	14	4	7	8	21	12	
11:15	20	1	45	8	65	9	
11:30	17	0	25	6	42	6	
11:45	28	0	21	1	49	1	28
Total	579	395	260	736	839	1131	
Percent	69.0%	34.9%	31.0%	65.1%			
Day Total	974		996		1970		
Peak	06:30	02:15	11:00	03:00	06:45	02:30	
Vol.	170	88	98	185	207	271	
P.H.F.	0.746	0.611	0.544	0.424	0.750	0.467	

Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink



133213 B VOLUME
Site Code: TBA

Start	NB		SB		Combined		01-Mar-13 Fri
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
12:00	1	25	0	16	1	41	
12:15	0	15	1	16	1	31	
12:30	0	16	4	14	4	30	
12:45	1	10	5	14	6	24	126
01:00	0	29	3	22	3	51	
01:15	2	11	5	13	7	24	
01:30	0	12	5	7	5	19	
01:45	1	21	0	13	1	34	128
02:00	2	18	2	24	4	42	
02:15	0	14	0	10	0	24	
02:30	1	7	1	26	2	33	
02:45	1	9	1	18	2	27	126
03:00	0	21	0	97	0	118	
03:15	0	11	0	15	0	26	
03:30	2	9	0	21	2	30	
03:45	2	9	2	22	4	31	205
04:00	1	7	0	30	1	37	
04:15	5	6	2	16	7	22	
04:30	2	6	0	19	2	25	
04:45	4	8	0	11	4	19	103
05:00	2	7	0	19	2	26	
05:15	2	8	1	14	3	22	
05:30	3	8	0	19	3	27	
05:45	21	3	4	11	25	14	89
06:00	12	1	1	11	13	12	
06:15	27	6	2	4	29	10	
06:30	14	3	4	12	18	15	
06:45	31	5	5	6	36	11	48
07:00	53	2	11	9	64	11	
07:15	47	4	11	8	58	12	
07:30	23	2	4	4	27	6	
07:45	12	0	8	5	20	5	34
08:00	19	0	4	3	23	3	
08:15	27	1	4	3	31	4	
08:30	28	0	2	5	30	5	
08:45	22	3	6	4	28	7	19
09:00	20	4	5	4	25	8	
09:15	14	2	5	2	19	4	
09:30	31	2	9	3	40	5	
09:45	14	2	18	7	32	9	26
10:00	17	1	8	3	25	4	
10:15	16	1	20	4	36	5	
10:30	13	2	13	5	26	7	
10:45	12	2	10	3	22	5	21
11:00	6	2	14	6	20	8	
11:15	18	1	42	3	60	4	
11:30	12	1	18	3	30	4	
11:45	38	1	19	4	57	5	21
Total	579	338	279	608	858	946	
Percent	67.5%	35.7%	32.5%	64.3%			
Day Total	917		887		1804		
Peak	06:45	01:00	11:00	02:30	06:45	03:00	
Vol.	154	73	93	156	185	205	
P.H.F.	0.726	0.629	0.554	0.402	0.723	0.434	

Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink



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133213 B VOLUME
Site Code: TBA

Start	NB		SB		Combined		02-Mar-13 Sat
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
12:00	0	9	6	18	6	27	
12:15	1	9	3	7	4	16	
12:30	2	13	1	12	3	25	
12:45	0	15	3	11	3	26	94
01:00	0	4	0	8	0	12	
01:15	0	8	0	3	0	11	
01:30	0	9	0	9	0	18	
01:45	0	10	0	5	0	15	56
02:00	0	17	0	19	0	36	
02:15	0	13	1	18	1	31	
02:30	0	6	0	18	0	24	
02:45	0	12	2	9	2	21	112
03:00	1	3	0	13	1	16	
03:15	0	3	1	15	1	18	
03:30	1	11	0	13	1	24	
03:45	2	2	0	2	2	4	62
04:00	1	4	0	3	1	7	
04:15	0	7	0	11	0	18	
04:30	2	5	0	8	2	13	
04:45	0	8	0	15	0	23	61
05:00	0	9	0	15	0	24	
05:15	2	3	0	5	2	8	
05:30	2	4	0	12	2	16	
05:45	9	3	2	6	11	9	57
06:00	9	2	4	9	13	11	
06:15	4	3	2	5	6	8	
06:30	7	3	1	6	8	9	
06:45	7	2	3	7	10	9	37
07:00	7	3	1	7	8	10	
07:15	9	2	2	8	11	10	
07:30	12	4	5	9	17	13	
07:45	11	2	2	5	13	7	40
08:00	4	4	2	5	6	9	
08:15	4	3	2	4	6	7	
08:30	12	0	4	3	16	3	
08:45	13	0	4	1	17	1	20
09:00	12	2	3	1	15	3	
09:15	13	1	5	3	18	4	
09:30	13	2	8	2	21	4	
09:45	18	0	5	1	23	1	12
10:00	7	2	6	0	13	2	
10:15	7	2	5	2	12	4	
10:30	9	1	11	4	20	5	
10:45	14	1	7	3	21	4	15
11:00	11	2	11	10	22	12	
11:15	5	0	1	2	6	2	
11:30	15	1	4	5	19	6	
11:45	10	0	18	2	28	2	22
Total	256	229	135	359	391	588	
Percent	65.5%	38.9%	34.5%	61.1%			
Day Total	485		494		979		
Peak	09:00	01:30	10:15	02:00	09:00	02:00	
Vol.	56	49	34	64	77	112	
P.H.F.	0.778	0.721	0.773	0.842	0.837	0.778	

Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink



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133213 B VOLUME
Site Code: TBA

Start	NB		SB		Combined		03-Mar-13 Sun	
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.		
12:00	0	7	0	9	0	16		
12:15	2	4	2	7	4	11		
12:30	0	9	1	1	1	10		
12:45	2	4	1	4	3	8	45	
01:00	0	2	1	3	1	5		
01:15	1	6	1	5	2	11		
01:30	0	11	0	4	0	15		
01:45	0	1	1	2	1	13	44	
02:00	1	10	2	9	3	19		
02:15	0	11	1	5	1	16		
02:30	1	8	0	22	1	30		
02:45	0	2	1	13	1	19	84	
03:00	1	6	1	11	2	17		
03:15	0	3	0	11	0	14		
03:30	0	3	0	4	0	7		
03:45	2	3	0	9	2	13	51	
04:00	0	2	0	6	0	8		
04:15	2	4	2	11	4	15		
04:30	0	6	1	10	1	16		
04:45	3	5	1	2	4	5	44	
05:00	1	12	0	6	1	18		
05:15	0	6	0	7	0	13		
05:30	5	3	0	13	5	16		
05:45	9	15	2	6	11	10	57	
06:00	0	3	1	10	1	13		
06:15	2	3	0	5	2	8		
06:30	8	3	0	8	8	11		
06:45	7	17	4	5	11	12	44	
07:00	9	9	2	14	11	23		
07:15	5	6	0	8	5	14		
07:30	6	6	4	12	10	18		
07:45	5	25	3	2	8	6	61	
08:00	1	3	5	7	6	10		
08:15	5	1	3	3	8	4		
08:30	5	3	1	2	6	5		
08:45	8	19	4	13	12	7	26	
09:00	5	2	3	2	8	4		
09:15	2	2	1	4	3	6		
09:30	8	5	3	4	11	9		
09:45	10	25	1	6	11	7	26	
10:00	4	0	5	1	9	1		
10:15	5	0	4	4	9	4		
10:30	6	2	4	5	10	7		
10:45	6	21	7	3	13	5	17	
11:00	5	1	3	7	8	8		
11:15	7	0	7	0	14	0		
11:30	5	1	5	3	10	4		
11:45	7	24	7	2	14	2	14	
Total	161	208	95	305	256	513		
Percent	62.9%	40.5%	37.1%	59.5%				
Day Total		369		400		769		
Peak	06:30	01:30	10:45	02:30	11:00	02:00		
Vol.	29	43	22	57	46	84		
P.H.F.	0.806	0.977	0.786	0.648	0.821	0.700		

Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink



133213 B VOLUME
Site Code: TBA

Start	NB		SB		Combined		04-Mar-13 Mon
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
12:00	1	25	1	17	2	42	
12:15	1	17	1	11	2	28	
12:30	1	24	0	15	1	39	
12:45	0	19	1	15	1	34	143
01:00	1	21	0	14	1	35	
01:15	1	26	3	16	4	42	
01:30	0	11	0	13	0	24	
01:45	0	13	3	14	3	27	128
02:00	0	22	0	13	0	35	
02:15	0	19	2	12	2	31	
02:30	0	19	0	24	0	43	
02:45	0	25	0	17	0	42	151
03:00	0	27	0	103	0	130	
03:15	0	9	0	21	0	30	
03:30	0	6	0	29	0	35	
03:45	3	12	0	16	3	28	223
04:00	3	8	3	20	6	28	
04:15	2	5	0	18	2	23	
04:30	5	13	1	21	6	34	
04:45	2	13	2	19	4	32	117
05:00	8	8	4	25	12	33	
05:15	4	3	1	13	5	16	
05:30	10	11	3	21	13	32	
05:45	28	6	1	14	29	20	101
06:00	12	3	3	18	15	21	
06:15	12	4	3	13	15	17	
06:30	33	9	0	18	33	27	
06:45	30	6	7	10	37	16	81
07:00	65	5	9	12	74	17	
07:15	48	3	17	10	65	13	
07:30	20	2	9	7	29	9	
07:45	13	1	11	5	24	6	45
08:00	15	5	3	14	18	19	
08:15	16	2	8	4	24	6	
08:30	19	0	8	4	27	4	
08:45	21	1	5	5	26	6	35
09:00	16	2	4	1	20	3	
09:15	23	3	7	5	30	8	
09:30	18	4	8	6	26	10	
09:45	25	3	7	6	32	9	30
10:00	22	1	13	3	35	4	
10:15	19	2	9	1	28	3	
10:30	19	1	10	0	29	1	
10:45	11	0	16	3	27	3	11
11:00	10	0	11	5	21	5	
11:15	15	0	32	5	47	5	
11:30	14	1	16	6	30	7	
11:45	26	2	16	3	42	5	22
Total	592	422	258	665	850	1087	
Percent	69.6%	38.8%	30.4%	61.2%			
Day Total	1014		923		1937		
Peak	06:30	00:30	10:45	02:45	06:30	02:15	
Vol.	176	90	75	170	209	246	
P.H.F.	0.677	0.865	0.586	0.413	0.706	0.473	

Hanscom Drive
north of Vandenberg Drive
City, State: Bedford, MA
Client: Toole Design/ C. Fink



133213 B VOLUME
Site Code: TBA

Start Time	26-Feb-13		27-Feb-13		28-Feb-13		01-Mar-13		02-Mar-13		03-Mar-13		04-Mar-13		Week Average	
	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
12:00 AM	0	6	1	31	0	2	2	10	3	13	4	4	3	3	2	10
01:00	1	3	2	7	0	2	3	13	0	0	1	3	2	6	1	5
02:00	3	1	2	7	1	6	4	4	0	3	2	4	0	2	2	4
03:00	5	2	4	1	4	2	4	2	4	1	3	1	3	0	4	1
04:00	10	3	8	3	8	1	12	2	3	0	5	4	12	6	8	3
05:00	31	23	25	3	39	7	28	5	13	2	15	2	50	9	29	7
06:00	100	29	78	9	90	18	84	12	27	10	17	5	87	13	69	14
07:00	151	40	123	30	153	42	135	34	39	10	25	9	146	46	110	30
08:00	79	23	73	24	86	20	96	16	33	12	19	13	71	24	65	19
09:00	77	35	70	25	67	30	79	37	56	21	25	8	82	26	65	26
10:00	65	40	46	32	52	32	58	51	37	29	21	20	71	48	50	36
11:00	82	89	59	64	79	98	74	93	41	34	24	22	65	75	61	68
12:00 PM	70	59	46	45	64	49	66	60	46	48	24	21	85	58	57	49
01:00	61	61	59	41	60	49	73	55	31	25	30	14	71	57	55	43
02:00	56	74	53	75	73	85	48	78	48	64	35	49	85	66	57	70
03:00	63	172	53	158	66	185	50	155	19	43	16	35	54	169	46	131
04:00	20	77	32	77	28	105	27	76	24	37	15	29	39	78	26	68
05:00	28	75	25	64	31	71	26	63	19	38	25	32	28	73	26	59
06:00	23	50	27	65	19	56	15	33	10	27	14	30	22	59	19	46
07:00	10	38	14	39	21	32	8	26	11	29	25	36	11	34	14	33
08:00	11	21	10	20	11	37	4	15	7	13	8	18	8	27	8	22
09:00	7	21	7	18	8	24	10	16	5	7	10	16	12	18	8	17
10:00	7	12	5	12	9	20	6	15	6	9	4	13	4	7	6	13
11:00	2	16	3	19	5	23	5	16	3	19	2	12	3	19	3	18
Total	962	970	825	869	974	996	917	887	485	494	369	400	1014	923	791	792
Day	1932		1694		1970		1804		979		769		1937		1583	
AM Peak	07:00	11:00	07:00	11:00	07:00	11:00	07:00	11:00	09:00	11:00	07:00	11:00	07:00	11:00	07:00	11:00
Vol.	151	89	123	64	153	98	135	93	56	34	25	22	146	75	110	68
PM Peak	12:00	15:00	13:00	15:00	14:00	15:00	13:00	15:00	14:00	14:00	14:00	14:00	12:00	15:00	12:00	15:00
Vol.	70	172	59	158	73	185	73	155	48	64	35	49	85	169	57	131

Comb. Total	1932	1694	1970	1804	979	769	1937	1583
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ADT	ADT 1,584	AADT 1,584
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Appendix C-4

2012 Vehicle Occupancy Survey

Hanscom Drive AM Vehicle Occupancy Counts

Date: 12/19/2013

Time: 6:00 AM - 9:00 AM

Major Street: N/S: Hanscom Drive

Minor Street: E/W: Old Bedford Road

City, State: Lexington, MA

Start Time	Entering Hanscom Drive From South				Exiting Hanscom Drive From South			
	1	2	3+	Total	1	2	3+	Total
06:00 AM	6	0	0	6	0	0	0	0
06:15 AM	24	2	0	26	2	0	0	2
06:30 AM	16	2	0	18	4	0	0	4
06:45 AM	24	2	0	26	4	0	0	4
07:00 AM	46	3	0	49	9	0	0	9
07:15 AM	60	7	1	68	5	0	0	5
07:30 AM	34	2	0	36	3	0	0	3
07:45 AM	20	2	1	23	5	0	0	5
08:00 AM	8	4	0	12	9	1	0	10
08:15 AM	16	2	0	18	10	0	0	10
08:30 AM	16	2	1	19	8	0	0	8
08:45 AM	13	1	0	14	6	0	0	6

Hanscom Drive PM Vehicle Occupancy Counts

Date: 12/17/2013

Time: 3:00 PM - 6:00 PM

Major Street: N/S: Hanscom Drive

Minor Street: E/W: Old Bedford Road

City, State: Lexington, MA





















Start Time	Entering Hanscom Drive From South				Exiting Hanscom Drive From North			
	1	2	3+	Total	1	2	3+	Total
3:00:00 PM	25	1	0	26	81	15	3	99
3:15:00 PM	11	1	0	12	12	3	0	15
3:30:00 PM	4	0	0	4	23	0	0	23
3:45:00 PM	11	1	1	13	21	1	0	22
4:00:00 PM	7	0	0	7	27	0	0	27
4:15:00 PM	4	1	0	5	10	3	0	13
4:30:00 PM	6	0	0	6	17	2	0	19
4:45:00 PM	7	1	0	8	15	1	0	16
5:00:00 PM	7	1	0	8	15	1	0	16
5:15:00 PM	3	1	0	4	10	1	0	11
5:30:00 PM	4	0	0	4	18	1	0	19
5:45:00 PM	4	0	0	4	12	3	0	15

Appendix C-5

SYNCHRO Level of Service Analysis: 2012

Lanes, Volumes, Timings
5: Old Bedford Rd & Hanscom Dr

Existing AM Peak
9/23/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 						 	
Volume (vph)	34	216	0	0	19	1	137	101	0	3	23	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		230	0		0	0		0	0		230
Storage Lanes	0		0	0		0	0		0	0		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Lane Util. Factor	0.95	0.95	1.00	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.991							0.850
Flt Protected		0.991						0.975			0.996	
Satd. Flow (prot)	0	3548	0	0	3578	0	0	1852	0	0	1690	1615
Flt Permitted		0.991						0.975			0.996	
Satd. Flow (perm)	0	3548	0	0	3578	0	0	1852	0	0	1690	1615
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		592			394			514			456	
Travel Time (s)		13.5			9.0			11.7			10.4	
Peak Hour Factor	0.59	0.79	0.81	0.92	0.59	0.50	0.83	0.66	0.92	0.92	0.64	1.00
Heavy Vehicles (%)	0%	1%	2%	0%	0%	0%	0%	0%	0%	0%	13%	0%
Adj. Flow (vph)	58	273	0	0	32	2	165	153	0	3	36	3
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	331	0	0	34	0	0	318	0	0	39	3
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 36.5% ICU Level of Service A





















Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

5: Old Bedford Rd & Hanscom Dr












Existing AM Peak

9/23/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 						 	
Volume (veh/h)	34	216	0	0	19	1	137	101	0	3	23	3
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.59	0.79	0.81	0.92	0.59	0.50	0.83	0.66	0.92	0.92	0.64	1.00
Hourly flow rate (vph)	58	273	0	0	32	2	165	153	0	3	36	3
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	544	526	36	662	526	153	36			153		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	544	526	36	662	526	153	36			153		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	85	33	100	100	92	100	90			100		
cM capacity (veh/h)	391	410	1037	163	411	898	1588			1440		
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1	SB 2					
Volume Total	149	182	21	13	318	39	3					
Volume Left	58	0	0	0	165	3	0					
Volume Right	0	0	0	2	0	0	3					
cSH	402	410	411	450	1588	1440	1700					
Volume to Capacity	0.37	0.44	0.05	0.03	0.10	0.00	0.00					
Queue Length 95th (ft)	42	56	4	2	9	0	0					
Control Delay (s)	19.1	20.6	14.2	13.2	4.3	0.6	0.0					
Lane LOS	C	C	B	B	A	A						
Approach Delay (s)	19.9		13.9		4.3	0.6						
Approach LOS	C		B									
Intersection Summary												
Average Delay			11.7									
Intersection Capacity Utilization			36.5%		ICU Level of Service					A		
Analysis Period (min)			15									

Lanes, Volumes, Timings
6: Route 2A & Hanscom Dr

Existing AM Peak
9/23/2013

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	278	821	397	318	106	118
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	75			0	0	0
Storage Lanes	1			0	1	1
Taper Length (ft)	25			25	25	25
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.939			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1787	1863	1708	0	1671	1583
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1787	1863	1708	0	1671	1583
Link Speed (mph)		30	30		30	
Link Distance (ft)		753	771		267	
Travel Time (s)		17.1	17.5		6.1	
Peak Hour Factor	0.87	0.95	0.86	0.84	0.80	0.73
Heavy Vehicles (%)	1%	2%	4%	5%	8%	2%
Adj. Flow (vph)	320	864	462	379	133	162
Shared Lane Traffic (%)						
Lane Group Flow (vph)	320	864	841	0	132	162
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized












Intersection Capacity Utilization 71.6% ICU Level of Service C

Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis










6: Route 2A & Hanscom Dr

Existing AM Peak
9/23/2013

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	278	821	397	318	106	118
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.87	0.95	0.86	0.84	0.80	0.73
Hourly flow rate (vph)	320	864	462	379	132	162
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	462				2154	651
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	462				2154	651
tC, single (s)	4.1				6.5	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.3
p0 queue free %	71				0	66
cM capacity (veh/h)	1105				36	469
Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2	
Volume Total	320	864	840	132	162	
Volume Left	320	0	0	132	0	
Volume Right	0	0	379	0	162	
cSH	1105	1700	1700	36	469	
Volume to Capacity	0.29	0.51	0.49	3.69	0.34	
Queue Length 95th (ft)	30	0	0	Err	38	
Control Delay (s)	9.6	0.0	0.0	Err	16.7	
Lane LOS	A			F	C	
Approach Delay (s)	2.6		0.0	4513.3		
Approach LOS				F		
Intersection Summary						
Average Delay			574.0			
Intersection Capacity Utilization			71.6%	ICU Level of Service		C
Analysis Period (min)			15			

Lanes, Volumes, Timings
10: Virginia Rd & Old Bedford Rd

Existing AM Peak
9/23/2013

						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	34	18	143	282	149	185
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.957		0.913			
Flt Protected	0.967					0.978
Satd. Flow (prot)	1723	0	1723	0	0	1838
Flt Permitted	0.967					0.978
Satd. Flow (perm)	1723	0	1723	0	0	1838
Link Speed (mph)	30		30			30
Link Distance (ft)	634		229			338
Travel Time (s)	14.4		5.2			7.7
Peak Hour Factor	0.65	0.75	0.87	0.94	0.82	0.82
Heavy Vehicles (%)	3%	0%	2%	0%	0%	2%
Adj. Flow (vph)	52	24	164	300	182	226
Shared Lane Traffic (%)						
Lane Group Flow (vph)	76	0	464	0	0	408
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other

Control Type: Unsignalized










Intersection Capacity Utilization 56.2% ICU Level of Service B

Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis





















10: Virginia Rd & Old Bedford Rd

Existing AM Peak
9/23/2013

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	34	18	143	282	149	185
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.65	0.75	0.87	0.94	0.82	0.82
Hourly flow rate (vph)	52	24	164	300	182	226
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	903	314			464	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	903	314			464	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	80	97			84	
cM capacity (veh/h)	256	731			1108	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	76	464	407			
Volume Left	52	0	182			
Volume Right	24	300	0			
cSH	322	1700	1108			
Volume to Capacity	0.24	0.27	0.16			
Queue Length 95th (ft)	23	0	15			
Control Delay (s)	19.6	0.0	4.9			
Lane LOS	C		A			
Approach Delay (s)	19.6	0.0	4.9			
Approach LOS	C					
Intersection Summary						
Average Delay		3.7				
Intersection Capacity Utilization		56.2%		ICU Level of Service		B
Analysis Period (min)		15				

Lanes, Volumes, Timings
5: Old Bedford Rd & Hanscom Dr

Existing PM Peak
9/23/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 						 	
Volume (vph)	5	21	0	0	220	2	30	100	0	3	77	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		230	0		0	0		0	0		230
Storage Lanes	0		0	0		0	0		0	0		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Lane Util. Factor	0.95	0.95	1.00	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.998							0.850
Flt Protected		0.988						0.989			0.998	
Satd. Flow (prot)	0	3567	0	0	3603	0	0	1879	0	0	1825	1615
Flt Permitted		0.988						0.989			0.998	
Satd. Flow (perm)	0	3567	0	0	3603	0	0	1879	0	0	1825	1615
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		592			394			514			456	
Travel Time (s)		13.5			9.0			11.7			10.4	
Peak Hour Factor	0.63	0.88	0.66	0.92	0.76	0.50	0.92	0.82	0.82	0.92	0.84	0.50
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	4%	0%
Adj. Flow (vph)	8	24	0	0	289	4	33	122	0	3	92	8
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	32	0	0	293	0	0	155	0	0	95	8
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 26.4%

ICU Level of Service A


















Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

5: Old Bedford Rd & Hanscom Dr












Existing PM Peak

9/23/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	5	21	0	0	220	2	30	100	0	3	77	4
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.63	0.88	0.66	0.92	0.76	0.50	0.92	0.82	0.82	0.92	0.84	0.50
Hourly flow rate (vph)	8	24	0	0	289	4	33	122	0	3	92	8
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	434	285	92	297	285	122	92			122		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	434	285	92	297	285	122	92			122		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	98	96	100	100	53	100	98			100		
cM capacity (veh/h)	330	613	971	628	613	935	1516			1478		
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1	SB 2					
Volume Total	16	16	193	100	155	95	8					
Volume Left	8	0	0	0	33	3	0					
Volume Right	0	0	0	4	0	0	8					
cSH	429	613	613	621	1516	1478	1700					
Volume to Capacity	0.04	0.03	0.32	0.16	0.02	0.00	0.00					
Queue Length 95th (ft)	3	2	34	14	2	0	0					
Control Delay (s)	13.7	11.0	13.6	11.9	1.7	0.3	0.0					
Lane LOS	B	B	B	B	A	A						
Approach Delay (s)	12.4		13.0		1.7	0.3						
Approach LOS	B		B									
Intersection Summary												
Average Delay			7.7									
Intersection Capacity Utilization			26.4%		ICU Level of Service					A		
Analysis Period (min)			15									

Lanes, Volumes, Timings
6: Route 2A & Hanscom Dr

Existing PM Peak
9/23/2013

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	89	333	831	162	249	380
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	75			0	0	0
Storage Lanes	1			0	1	1
Taper Length (ft)	25			25	25	25
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.973			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1787	1845	1830	0	1787	1599
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1787	1845	1830	0	1787	1599
Link Speed (mph)		30	30		30	
Link Distance (ft)		743	582		267	
Travel Time (s)		16.9	13.2		6.1	
Peak Hour Factor	0.87	0.96	0.95	0.75	0.83	0.89
Heavy Vehicles (%)	1%	3%	1%	1%	1%	1%
Adj. Flow (vph)	102	347	875	216	300	427
Shared Lane Traffic (%)						
Lane Group Flow (vph)	102	347	1091	0	300	427
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized












Intersection Capacity Utilization 83.8% ICU Level of Service E

Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

6: Route 2A & Hanscom Dr










Existing PM Peak
9/23/2013

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	89	333	831	162	249	380
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.87	0.96	0.95	0.75	0.83	0.89
Hourly flow rate (vph)	102	347	875	216	300	427
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	875				1534	983
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	875				1534	983
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	87				0	0
cM capacity (veh/h)	776				112	303
Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2	
Volume Total	102	347	1091	300	427	
Volume Left	102	0	0	300	0	
Volume Right	0	0	216	0	427	
cSH	776	1700	1700	112	303	
Volume to Capacity	0.13	0.20	0.64	2.68	1.41	
Queue Length 95th (ft)	11	0	0	690	564	
Control Delay (s)	10.3	0.0	0.0	843.3	234.9	
Lane LOS	B			F	F	
Approach Delay (s)	2.4		0.0	486.0		
Approach LOS				F		
Intersection Summary						
Average Delay			156.3			
Intersection Capacity Utilization			83.8%	ICU Level of Service		E
Analysis Period (min)			15			

Lanes, Volumes, Timings
10: Virginia Rd & Old Bedford Rd

Existing PM Peak

9/23/2013

						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	133	296	184	70	15	131
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.907		0.952			
Flt Protected	0.985					0.994
Satd. Flow (prot)	1692	0	1778	0	0	1872
Flt Permitted	0.985					0.994
Satd. Flow (perm)	1692	0	1778	0	0	1872
Link Speed (mph)	30		30			30
Link Distance (ft)	634		229			338
Travel Time (s)	14.4		5.2			7.7
Peak Hour Factor	0.85	0.87	0.72	0.50	0.75	0.90
Heavy Vehicles (%)	1%	0%	1%	3%	0%	1%
Adj. Flow (vph)	156	340	256	140	20	146
Shared Lane Traffic (%)						
Lane Group Flow (vph)	496	0	396	0	0	166
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other

Control Type: Unsignalized










Intersection Capacity Utilization 51.7% ICU Level of Service A

Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

10: Virginia Rd & Old Bedford Rd

Existing PM Peak
9/23/2013

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	133	296	184	70	15	131
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.85	0.87	0.72	0.50	0.75	0.90
Hourly flow rate (vph)	156	340	256	140	20	146
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	511	326			396	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	511	326			396	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	70	53			98	
cM capacity (veh/h)	515	720			1174	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	497	396	166			
Volume Left	156	0	20			
Volume Right	340	140	0			
cSH	640	1700	1174			
Volume to Capacity	0.78	0.23	0.02			
Queue Length 95th (ft)	184	0	1			
Control Delay (s)	27.3	0.0	1.1			
Lane LOS	D		A			
Approach Delay (s)	27.3	0.0	1.1			
Approach LOS	D					
Intersection Summary						
Average Delay		13.0				
Intersection Capacity Utilization		51.7%	ICU Level of Service	A		
Analysis Period (min)		15				






















Appendix C-6

SYNCHRO LOS Analysis: 2020 No Build

Lanes, Volumes, Timings
5: Old Bedford Rd & Hanscom Dr

2020 AM Peak No Build

9/23/2013






















												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 			 			 	
Volume (vph)	34	225	0	0	21	0	143	106	0	3	23	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	12
Grade (%)		0%			0%			0%			0%	
Storage Length (ft)	0		230	0		0	0		0	0		230
Storage Lanes	0		0	0		0	0		0	0		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Lane Util. Factor	0.95	0.95	1.00	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor												
Frt												0.850
Flt Protected		0.992						0.975			0.996	
Satd. Flow (prot)	0	3552	0	0	3610	0	0	1852	0	0	1690	1615
Flt Permitted		0.992						0.975			0.996	
Satd. Flow (perm)	0	3552	0	0	3610	0	0	1852	0	0	1690	1615
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		592			394			514			456	
Travel Time (s)		13.5			9.0			11.7			10.4	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.59	0.79	0.81	0.92	0.59	0.50	0.83	0.66	0.92	0.92	0.64	1.00
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	0%	1%	2%	0%	0%	0%	0%	0%	0%	0%	13%	0%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Adj. Flow (vph)	58	285	0	0	36	0	172	161	0	3	36	3
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	343	0	0	36	0	0	333	0	0	39	3
Sign Control		Stop			Stop			Free			Free	
Intersection Summary												
Area Type:	Other											
Control Type:	Unsignalized											
Intersection Capacity Utilization 37.3%	ICU Level of Service A											
Analysis Period (min) 15												

HCM Unsignalized Intersection Capacity Analysis

5: Old Bedford Rd & Hanscom Dr

2020 AM Peak No Build












9/23/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 			 			 	
Volume (veh/h)	34	225	0	0	21	0	143	106	0	3	23	3
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.59	0.79	0.81	0.92	0.59	0.50	0.83	0.66	0.92	0.92	0.64	1.00
Hourly flow rate (vph)	58	285	0	0	36	0	172	161	0	3	36	3
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	565	548	36	690	548	161	36			161		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	565	548	36	690	548	161	36			161		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	85	28	100	100	91	100	89			100		
cM capacity (veh/h)	374	396	1037	140	398	890	1588			1431		
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1	SB 2					
Volume Total	153	190	24	12	333	39	3					
Volume Left	58	0	0	0	172	3	0					
Volume Right	0	0	0	0	0	0	3					
cSH	388	396	398	398	1588	1431	1700					
Volume to Capacity	0.39	0.48	0.06	0.03	0.11	0.00	0.00					
Queue Length 95th (ft)	46	63	5	2	9	0	0					
Control Delay (s)	20.2	22.2	14.6	14.3	4.3	0.6	0.0					
Lane LOS	C	C	B	B	A	A						
Approach Delay (s)	21.3		14.5		4.3	0.6						
Approach LOS	C		B									
Intersection Summary												
Average Delay			12.3									
Intersection Capacity Utilization			37.3%		ICU Level of Service					A		
Analysis Period (min)			15									

Lanes, Volumes, Timings
6: Route 2A & Hanscom Dr

2020 AM Peak No Build












9/23/2013

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	289	854	413	453	135	139
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12
Grade (%)		0%	0%		0%	
Storage Length (ft)	75			0	0	0
Storage Lanes	1			0	1	1
Taper Length (ft)	25			25	25	25
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt			0.929			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1787	1863	1689	0	1671	1583
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1787	1863	1689	0	1671	1583
Link Speed (mph)		30	30		30	
Link Distance (ft)		753	771		267	
Travel Time (s)		17.1	17.5		6.1	
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.87	0.95	0.86	0.84	0.80	0.73
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	1%	2%	4%	5%	8%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)		0%	0%		0%	
Adj. Flow (vph)	332	899	480	539	169	190
Shared Lane Traffic (%)						
Lane Group Flow (vph)	332	899	1019	0	169	190
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	83.0%			ICU Level of Service E		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis










6: Route 2A & Hanscom Dr

2020 AM Peak No Build
9/23/2013

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	289	854	413	453	135	139
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.87	0.95	0.86	0.84	0.80	0.73
Hourly flow rate (vph)	332	899	480	539	169	190
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	480				2313	750
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	480				2313	750
tC, single (s)	4.1				6.5	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.3
p0 queue free %	69				0	54
cM capacity (veh/h)	1087				28	411
Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2	
Volume Total	332	899	1020	169	190	
Volume Left	332	0	0	169	0	
Volume Right	0	0	539	0	190	
cSH	1087	1700	1700	28	411	
Volume to Capacity	0.31	0.53	0.60	6.07	0.46	
Queue Length 95th (ft)	33	0	0	Err	60	
Control Delay (s)	9.8	0.0	0.0	Err	21.1	
Lane LOS	A			F	C	
Approach Delay (s)	2.6		0.0	4709.2		
Approach LOS				F		
Intersection Summary						
Average Delay			649.3			
Intersection Capacity Utilization			83.0%	ICU Level of Service		E
Analysis Period (min)			15			

Lanes, Volumes, Timings
10: Virginia Rd & Old Bedford Rd

2020 AM Peak No Build
9/23/2013










						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	35	19	150	295	156	194
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12
Grade (%)	0%		0%			0%
Storage Length (ft)	0	0		0	0	
Storage Lanes	1	0		0	0	
Taper Length (ft)	25	25		25	25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt	0.957		0.913			
Flt Protected	0.967					0.978
Satd. Flow (prot)	1723	0	1723	0	0	1838
Flt Permitted	0.967					0.978
Satd. Flow (perm)	1723	0	1723	0	0	1838
Link Speed (mph)	30		30			30
Link Distance (ft)	634		229			338
Travel Time (s)	14.4		5.2			7.7
Confl. Peds. (#/hr)						
Confl. Bikes (#/hr)						
Peak Hour Factor	0.65	0.75	0.87	0.94	0.82	0.82
Growth Factor	100%	100%	100%	100%	100%	100%
Heavy Vehicles (%)	3%	0%	2%	0%	0%	2%
Bus Blockages (#/hr)	0	0	0	0	0	0
Parking (#/hr)						
Mid-Block Traffic (%)	0%		0%			0%
Adj. Flow (vph)	54	25	172	314	190	237
Shared Lane Traffic (%)						
Lane Group Flow (vph)	79	0	486	0	0	427
Sign Control	Stop		Free			Free
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	58.2%			ICU Level of Service B		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis

10: Virginia Rd & Old Bedford Rd

2020 AM Peak No Build






















9/23/2013

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	35	19	150	295	156	194
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.65	0.75	0.87	0.94	0.82	0.82
Hourly flow rate (vph)	54	25	172	314	190	237
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	946	329			486	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	946	329			486	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	77	96			83	
cM capacity (veh/h)	238	717			1087	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	79	486	427			
Volume Left	54	0	190			
Volume Right	25	314	0			
cSH	303	1700	1087			
Volume to Capacity	0.26	0.29	0.17			
Queue Length 95th (ft)	26	0	16			
Control Delay (s)	21.0	0.0	5.0			
Lane LOS	C		A			
Approach Delay (s)	21.0	0.0	5.0			
Approach LOS	C					
Intersection Summary						
Average Delay		3.8				
Intersection Capacity Utilization		58.2%	ICU Level of Service		B	
Analysis Period (min)		15				

Lanes, Volumes, Timings
5: Old Bedford Rd & Hanscom Dr

2020 PM Peak No Build

9/23/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 			 			 	
Volume (vph)	5	22	0	0	231	4	104	30	0	3	78	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		230	0		0	0		0	0		230
Storage Lanes	0		0	0		0	0		0	0		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Lane Util. Factor	0.95	0.95	1.00	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.996							0.850
Flt Protected		0.988						0.964			0.998	
Satd. Flow (prot)	0	3567	0	0	3596	0	0	1832	0	0	1825	1615
Flt Permitted		0.988						0.964			0.998	
Satd. Flow (perm)	0	3567	0	0	3596	0	0	1832	0	0	1825	1615
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		592			394			514			456	
Travel Time (s)		13.5			9.0			11.7			10.4	
Peak Hour Factor	0.63	0.88	0.66	0.92	0.76	0.50	0.92	0.82	0.82	0.92	0.84	0.50
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	4%	0%
Adj. Flow (vph)	8	25	0	0	304	8	113	37	0	3	93	8
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	33	0	0	312	0	0	150	0	0	96	8
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 27.2%

ICU Level of Service A


















Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

5: Old Bedford Rd & Hanscom Dr

2020 PM Peak No Build












9/23/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	5	22	0	0	231	4	104	30	0	3	78	4
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.63	0.88	0.66	0.92	0.76	0.50	0.92	0.82	0.82	0.92	0.84	0.50
Hourly flow rate (vph)	8	25	0	0	304	8	113	37	0	3	93	8
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	522	362	93	375	362	37	93			37		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	522	362	93	375	362	37	93			37		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	97	95	100	100	42	99	93			100		
cM capacity (veh/h)	238	525	970	532	525	1042	1514			1587		
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1	SB 2					
Volume Total	16	17	203	109	150	96	8					
Volume Left	8	0	0	0	113	3	0					
Volume Right	0	0	0	8	0	0	8					
cSH	331	525	525	545	1514	1587	1700					
Volume to Capacity	0.05	0.03	0.39	0.20	0.07	0.00	0.00					
Queue Length 95th (ft)	4	2	45	19	6	0	0					
Control Delay (s)	16.5	12.1	16.1	13.3	5.9	0.3	0.0					
Lane LOS	C	B	C	B	A	A						
Approach Delay (s)	14.2		15.1		5.9	0.2						
Approach LOS	B		C									
Intersection Summary												
Average Delay			10.2									
Intersection Capacity Utilization			27.2%		ICU Level of Service					A		
Analysis Period (min)			15									

Lanes, Volumes, Timings
6: Route 2A & Hanscom Dr

2020 PM Peak No Build

9/23/2013

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	92	341	851	187	367	459
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	75			0	0	0
Storage Lanes	1			0	1	1
Taper Length (ft)	25			25	25	25
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.971			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1787	1845	1827	0	1787	1599
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1787	1845	1827	0	1787	1599
Link Speed (mph)		30	30		30	
Link Distance (ft)		743	582		267	
Travel Time (s)		16.9	13.2		6.1	
Peak Hour Factor	0.87	0.96	0.95	0.75	0.83	0.89
Heavy Vehicles (%)	1%	3%	1%	1%	1%	1%
Adj. Flow (vph)	106	355	896	249	442	516
Shared Lane Traffic (%)						
Lane Group Flow (vph)	106	355	1145	0	442	516
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		12	12		12	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15			9	15	9
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 91.6% ICU Level of Service F












Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

6: Route 2A & Hanscom Dr










2020 PM Peak No Build

9/23/2013

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	92	341	851	187	367	459
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.87	0.96	0.95	0.75	0.83	0.89
Hourly flow rate (vph)	106	355	896	249	442	516
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	896				1587	1020
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	896				1587	1020
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	86				0	0
cM capacity (veh/h)	762				103	288
Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2	
Volume Total	106	355	1145	442	516	
Volume Left	106	0	0	442	0	
Volume Right	0	0	249	0	516	
cSH	762	1700	1700	103	288	
Volume to Capacity	0.14	0.21	0.67	4.30	1.79	
Queue Length 95th (ft)	12	0	0	Err	852	
Control Delay (s)	10.5	0.0	0.0	Err	398.6	
Lane LOS	B			F	F	
Approach Delay (s)	2.4		0.0	4830.1		
Approach LOS				F		
Intersection Summary						
Average Delay			1805.0			
Intersection Capacity Utilization			91.6%	ICU Level of Service		F
Analysis Period (min)			15			

Lanes, Volumes, Timings
10: Virginia Rd & Old Bedford Rd

2020 PM Peak No Build
9/23/2013










						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	139	309	193	73	16	137
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.908		0.952			
Flt Protected	0.984					0.994
Satd. Flow (prot)	1692	0	1778	0	0	1872
Flt Permitted	0.984					0.994
Satd. Flow (perm)	1692	0	1778	0	0	1872
Link Speed (mph)	30		30			30
Link Distance (ft)	634		229			338
Travel Time (s)	14.4		5.2			7.7
Peak Hour Factor	0.85	0.87	0.72	0.50	0.75	0.90
Heavy Vehicles (%)	1%	0%	1%	3%	0%	1%
Adj. Flow (vph)	164	355	268	146	21	152
Shared Lane Traffic (%)						
Lane Group Flow (vph)	519	0	414	0	0	173
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(ft)	12		0			0
Link Offset(ft)	0		0			0
Crosswalk Width(ft)	16		16			16
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9		9	15	
Sign Control	Stop		Free			Free
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	54.0%			ICU Level of Service A		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis

10: Virginia Rd & Old Bedford Rd

2020 PM Peak No Build

9/23/2013

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	139	309	193	73	16	137
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.85	0.87	0.72	0.50	0.75	0.90
Hourly flow rate (vph)	164	355	268	146	21	152
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	536	341			414	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	536	341			414	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	67	50			98	
cM capacity (veh/h)	498	706			1156	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	519	414	174			
Volume Left	164	0	21			
Volume Right	355	146	0			
cSH	624	1700	1156			
Volume to Capacity	0.83	0.24	0.02			
Queue Length 95th (ft)	221	0	1			
Control Delay (s)	32.8	0.0	1.2			
Lane LOS	D		A			
Approach Delay (s)	32.8	0.0	1.2			
Approach LOS	D					
Intersection Summary						
Average Delay		15.6				
Intersection Capacity Utilization		54.0%		ICU Level of Service		A
Analysis Period (min)		15				






















Appendix C-7

SYNCHRO LOS Analysis: 2020 Build

Lanes, Volumes, Timings
5: Old Bedford Rd & Hanscom Dr

2020 AM Peak

9/18/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 			 			 	
Volume (vph)	45	225	0	0	21	0	143	138	0	5	33	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		230	0		0	0		0	0		230
Storage Lanes	0		0	0		0	0		0	0		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Lane Util. Factor	0.95	0.95	1.00	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt												0.850
Flt Protected		0.990						0.978			0.996	
Satd. Flow (prot)	0	3546	0	0	3610	0	0	1858	0	0	1692	1615
Flt Permitted		0.990						0.978			0.996	
Satd. Flow (perm)	0	3546	0	0	3610	0	0	1858	0	0	1692	1615
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		592			394			514			456	
Travel Time (s)		13.5			9.0			11.7			10.4	
Peak Hour Factor	0.59	0.79	0.81	0.92	0.59	0.50	0.83	0.66	0.92	0.92	0.64	1.00
Heavy Vehicles (%)	0%	1%	2%	0%	0%	0%	0%	0%	0%	0%	13%	0%
Adj. Flow (vph)	76	285	0	0	36	0	172	209	0	5	52	5
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	361	0	0	36	0	0	381	0	0	57	5
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 39.3%

ICU Level of Service A






















Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

5: Old Bedford Rd & Hanscom Dr

2020 AM Peak












9/18/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 			 			 	
Volume (veh/h)	45	225	0	0	21	0	143	138	0	5	33	5
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.59	0.79	0.81	0.92	0.59	0.50	0.83	0.66	0.92	0.92	0.64	1.00
Hourly flow rate (vph)	76	285	0	0	36	0	172	209	0	5	52	5
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	634	616	52	759	616	209	52			209		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	634	616	52	759	616	209	52			209		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	77	21	100	100	90	100	89			100		
cM capacity (veh/h)	334	361	1016	105	362	836	1567			1374		
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1	SB 2					
Volume Total	171	190	24	12	381	57	5					
Volume Left	76	0	0	0	172	5	0					
Volume Right	0	0	0	0	0	0	5					
cSH	348	361	362	362	1567	1374	1700					
Volume to Capacity	0.49	0.53	0.07	0.03	0.11	0.00	0.00					
Queue Length 95th (ft)	65	73	5	3	9	0	0					
Control Delay (s)	24.9	25.5	15.6	15.3	3.9	0.8	0.0					
Lane LOS	C	D	C	C	A	A						
Approach Delay (s)	25.2		15.5		3.9	0.7						
Approach LOS	D		C									
Intersection Summary												
Average Delay			13.3									
Intersection Capacity Utilization			39.3%		ICU Level of Service					A		
Analysis Period (min)			15									

Lanes, Volumes, Timings
6: Route 2A & Hanscom Dr

2020 AM Peak

9/18/2013

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	304	854	413	470	140	144
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	75			0	0	0
Storage Lanes	1			0	1	1
Taper Length (ft)	25			25	25	25
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.927			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1787	1863	1685	0	1671	1583
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1787	1863	1685	0	1671	1583
Link Speed (mph)		30	30		30	
Link Distance (ft)		753	771		267	
Travel Time (s)		17.1	17.5		6.1	
Peak Hour Factor	0.87	0.95	0.86	0.84	0.80	0.73
Heavy Vehicles (%)	1%	2%	4%	5%	8%	2%
Adj. Flow (vph)	349	899	480	560	175	197
Shared Lane Traffic (%)						
Lane Group Flow (vph)	349	899	1040	0	175	197
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		12	12		12	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15			9	15	9
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized












Intersection Capacity Utilization 85.1% ICU Level of Service E

Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis










6: Route 2A & Hanscom Dr

2020 AM Peak
9/18/2013

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	304	854	413	470	140	144
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.87	0.95	0.86	0.84	0.80	0.73
Hourly flow rate (vph)	349	899	480	560	175	197
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	480				2358	760
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	480				2358	760
tC, single (s)	4.1				6.5	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.3
p0 queue free %	68				0	51
cM capacity (veh/h)	1087				25	406
Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2	
Volume Total	349	899	1040	175	197	
Volume Left	349	0	0	175	0	
Volume Right	0	0	560	0	197	
cSH	1087	1700	1700	25	406	
Volume to Capacity	0.32	0.53	0.61	6.89	0.49	
Queue Length 95th (ft)	35	0	0	Err	65	
Control Delay (s)	9.9	0.0	0.0	Err	22.0	
Lane LOS	A			F	C	
Approach Delay (s)	2.8		0.0	4712.2		
Approach LOS				F		
Intersection Summary						
Average Delay			660.7			
Intersection Capacity Utilization			85.1%	ICU Level of Service		E
Analysis Period (min)			15			

Lanes, Volumes, Timings
10: Virginia Rd & Old Bedford Rd










2020 AM Peak
9/18/2013

						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	35	19	150	301	160	194
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.957		0.912			
Flt Protected	0.967					0.978
Satd. Flow (prot)	1723	0	1721	0	0	1838
Flt Permitted	0.967					0.978
Satd. Flow (perm)	1723	0	1721	0	0	1838
Link Speed (mph)	30		30			30
Link Distance (ft)	634		229			338
Travel Time (s)	14.4		5.2			7.7
Peak Hour Factor	0.65	0.75	0.87	0.94	0.82	0.82
Heavy Vehicles (%)	3%	0%	2%	0%	0%	2%
Adj. Flow (vph)	54	25	172	320	195	237
Shared Lane Traffic (%)						
Lane Group Flow (vph)	79	0	492	0	0	432
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(ft)	12		0			0
Link Offset(ft)	0		0			0
Crosswalk Width(ft)	16		16			16
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9		9	15	
Sign Control	Stop		Free			Free
Intersection Summary						
Area Type:	Other					
Control Type: Unsignalized						
Intersection Capacity Utilization 58.8%			ICU Level of Service B			
Analysis Period (min) 15						

HCM Unsignalized Intersection Capacity Analysis

10: Virginia Rd & Old Bedford Rd






















2020 AM Peak
9/18/2013

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	35	19	150	301	160	194
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.65	0.75	0.87	0.94	0.82	0.82
Hourly flow rate (vph)	54	25	172	320	195	237
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	959	333			493	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	959	333			493	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	77	96			82	
cM capacity (veh/h)	233	714			1081	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	79	493	432			
Volume Left	54	0	195			
Volume Right	25	320	0			
cSH	297	1700	1081			
Volume to Capacity	0.27	0.29	0.18			
Queue Length 95th (ft)	26	0	16			
Control Delay (s)	21.5	0.0	5.1			
Lane LOS	C		A			
Approach Delay (s)	21.5	0.0	5.1			
Approach LOS	C					
Intersection Summary						
Average Delay			3.9			
Intersection Capacity Utilization		58.8%		ICU Level of Service		B
Analysis Period (min)		15				

Lanes, Volumes, Timings
5: Old Bedford Rd & Hanscom Dr

2020 PM Peak

9/19/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 			 			 	
Volume (vph)	6	22	0	0	231	4	104	37	0	4	111	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		230	0		0	0		0	0		230
Storage Lanes	0		0	0		0	0		0	0		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Lane Util. Factor	0.95	0.95	1.00	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.996							0.850
Flt Protected		0.986						0.965			0.999	
Satd. Flow (prot)	0	3559	0	0	3596	0	0	1834	0	0	1827	1615
Flt Permitted		0.986						0.965			0.999	
Satd. Flow (perm)	0	3559	0	0	3596	0	0	1834	0	0	1827	1615
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		592			394			514			456	
Travel Time (s)		13.5			9.0			11.7			10.4	
Peak Hour Factor	0.63	0.88	0.66	0.92	0.76	0.50	0.92	0.82	0.82	0.92	0.84	0.50
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	4%	0%
Adj. Flow (vph)	10	25	0	0	304	8	113	45	0	4	132	10
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	35	0	0	312	0	0	158	0	0	136	10
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 27.6%

ICU Level of Service A






















Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

5: Old Bedford Rd & Hanscom Dr

2020 PM Peak












9/19/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 			 			 	
Volume (veh/h)	6	22	0	0	231	4	104	37	0	4	111	5
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.63	0.88	0.66	0.92	0.76	0.50	0.92	0.82	0.82	0.92	0.84	0.50
Hourly flow rate (vph)	10	25	0	0	304	8	113	45	0	4	132	10
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	572	412	132	425	412	45	132			45		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	572	412	132	425	412	45	132			45		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	95	95	100	100	38	99	92			100		
cM capacity (veh/h)	206	491	923	491	491	1030	1465			1576		
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1	SB 2					
Volume Total	18	17	203	109	158	136	10					
Volume Left	10	0	0	0	113	4	0					
Volume Right	0	0	0	8	0	0	10					
cSH	282	491	491	510	1465	1576	1700					
Volume to Capacity	0.06	0.03	0.41	0.21	0.08	0.00	0.01					
Queue Length 95th (ft)	5	3	50	20	6	0	0					
Control Delay (s)	18.6	12.6	17.4	14.0	5.6	0.3	0.0					
Lane LOS	C	B	C	B	A	A						
Approach Delay (s)	15.7		16.2		5.6	0.2						
Approach LOS	C		C									
Intersection Summary												
Average Delay			10.0									
Intersection Capacity Utilization			27.6%		ICU Level of Service					A		
Analysis Period (min)			15									

Lanes, Volumes, Timings
6: Route 2A & Hanscom Dr

2020 PM Peak












9/19/2013

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	95	341	851	192	381	479
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	75			0	0	0
Storage Lanes	1			0	1	1
Taper Length (ft)	25			25	25	25
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.970			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1787	1845	1825	0	1787	1599
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1787	1845	1825	0	1787	1599
Link Speed (mph)		30	30		30	
Link Distance (ft)		743	582		267	
Travel Time (s)		16.9	13.2		6.1	
Peak Hour Factor	0.87	0.96	0.95	0.75	0.83	0.89
Heavy Vehicles (%)	1%	3%	1%	1%	1%	1%
Adj. Flow (vph)	109	355	896	256	459	538
Shared Lane Traffic (%)						
Lane Group Flow (vph)	109	355	1152	0	459	538
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		12	12		12	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15			9	15	9
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	92.8%			ICU Level of Service F		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis










6: Route 2A & Hanscom Dr

2020 PM Peak
9/19/2013

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	95	341	851	192	381	479
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.87	0.96	0.95	0.75	0.83	0.89
Hourly flow rate (vph)	109	355	896	256	459	538
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	896				1597	1024
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	896				1597	1024
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	86				0	0
cM capacity (veh/h)	762				101	287
Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2	
Volume Total	109	355	1152	459	538	
Volume Left	109	0	0	459	0	
Volume Right	0	0	256	0	538	
cSH	762	1700	1700	101	287	
Volume to Capacity	0.14	0.21	0.68	4.55	1.87	
Queue Length 95th (ft)	12	0	0	Err	922	
Control Delay (s)	10.5	0.0	0.0	Err	436.3	
Lane LOS	B			F	F	
Approach Delay (s)	2.5		0.0	4838.1		
Approach LOS				F		
Intersection Summary						
Average Delay			1846.6			
Intersection Capacity Utilization			92.8%	ICU Level of Service		F
Analysis Period (min)			15			

Lanes, Volumes, Timings
10: Virginia Rd & Old Bedford Rd

2020 PM Peak
9/19/2013










						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	139	310	193	73	17	137
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.908		0.952			
Flt Protected	0.984					0.993
Satd. Flow (prot)	1692	0	1778	0	0	1870
Flt Permitted	0.984					0.993
Satd. Flow (perm)	1692	0	1778	0	0	1870
Link Speed (mph)	30		30			30
Link Distance (ft)	634		229			338
Travel Time (s)	14.4		5.2			7.7
Peak Hour Factor	0.85	0.87	0.72	0.50	0.75	0.90
Heavy Vehicles (%)	1%	0%	1%	3%	0%	1%
Adj. Flow (vph)	164	356	268	146	23	152
Shared Lane Traffic (%)						
Lane Group Flow (vph)	520	0	414	0	0	175
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(ft)	12		0			0
Link Offset(ft)	0		0			0
Crosswalk Width(ft)	16		16			16
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9		9	15	
Sign Control	Stop		Free			Free
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	54.9%			ICU Level of Service A		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis

10: Virginia Rd & Old Bedford Rd

2020 PM Peak

9/19/2013

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	139	310	193	73	17	137
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.85	0.87	0.72	0.50	0.75	0.90
Hourly flow rate (vph)	164	356	268	146	23	152
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	539	341			414	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	539	341			414	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	67	50			98	
cM capacity (veh/h)	495	706			1156	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	520	414	175			
Volume Left	164	0	23			
Volume Right	356	146	0			
cSH	623	1700	1156			
Volume to Capacity	0.83	0.24	0.02			
Queue Length 95th (ft)	223	0	1			
Control Delay (s)	33.2	0.0	1.2			
Lane LOS	D		A			
Approach Delay (s)	33.2	0.0	1.2			
Approach LOS	D					
Intersection Summary						
Average Delay		15.8				
Intersection Capacity Utilization		54.9%		ICU Level of Service		A
Analysis Period (min)		15				




















Appendix C-8

SYNCHRO LOS Analysis: 2030 No Build

Lanes, Volumes, Timings
2: Route 2A & Mass Avenue

2030 AM Peak No Build













9/23/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	140	719	25	127	641	383	10	30	54	368	54	154
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	250		0	250		0	0		0	100		0
Storage Lanes	1		0	1		0	0		0	1		0
Taper Length (ft)	25		25	25		25	25		25	25		25
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.995			0.944			0.922			0.889	
Flt Protected	0.950			0.950				0.995		0.950		
Satd. Flow (prot)	1770	1853	0	1770	1758	0	0	1709	0	1770	1656	0
Flt Permitted	0.062			0.219				0.962		0.678		
Satd. Flow (perm)	115	1853	0	408	1758	0	0	1652	0	1263	1656	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		3			43			61			131	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1435			667			796			673	
Travel Time (s)		32.6			15.2			18.1			15.3	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	159	817	28	144	728	435	11	34	61	418	61	175
Shared Lane Traffic (%)												
Lane Group Flow (vph)	159	845	0	144	1163	0	0	106	0	418	236	0
Turn Type	pm+pt			Perm			Perm			Perm		
Protected Phases	7	4			8			2			6	
Permitted Phases	4			8			2			6		
Detector Phase	7	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	9.0	21.0		21.0	21.0		21.0	21.0		21.0	21.0	
Total Split (s)	9.0	74.0	0.0	65.0	65.0	0.0	36.0	36.0	0.0	36.0	36.0	0.0
Total Split (%)	8.2%	67.3%	0.0%	59.1%	59.1%	0.0%	32.7%	32.7%	0.0%	32.7%	32.7%	0.0%
Maximum Green (s)	4.0	69.0		60.0	60.0		31.0	31.0		31.0	31.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0
Lead/Lag	Lead			Lag	Lag							
Lead-Lag Optimize?	Yes			Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)		5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0		11.0	11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0		0	0		0	0		0	0	
Act Effect Green (s)	69.0	69.0		60.0	60.0			31.0		31.0	31.0	
Actuated g/C Ratio	0.63	0.63		0.55	0.55			0.28		0.28	0.28	
v/c Ratio	1.20	0.73		0.65	1.19			0.21		1.17	0.42	
Control Delay	164.5	18.6		34.0	120.4			15.4		140.6	16.6	
Queue Delay	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Total Delay	164.5	18.6		34.0	120.4			15.4		140.6	16.6	
LOS	F	B		C	F			B		F	B	

Lanes, Volumes, Timings
2: Route 2A & Mass Avenue

2030 AM Peak No Build

9/23/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		41.7			110.9			15.4			95.9	
Approach LOS		D			F			B			F	
Queue Length 50th (ft)	~62	376		68	~983			23		~354	57	
Queue Length 95th (ft)	#162	510		#160	#1197			65		#529	123	
Internal Link Dist (ft)		1355			587			716			593	
Turn Bay Length (ft)	250			250						100		
Base Capacity (vph)	132	1163		223	978			509		356	561	
Starvation Cap Reductn	0	0		0	0			0		0	0	
Spillback Cap Reductn	0	0		0	0			0		0	0	
Storage Cap Reductn	0	0		0	0			0		0	0	
Reduced v/c Ratio	1.20	0.73		0.65	1.19			0.21		1.17	0.42	

Intersection Summary

Area Type: Other

Cycle Length: 110

Actuated Cycle Length: 110

Natural Cycle: 110

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 1.20

Intersection Signal Delay: 81.8

Intersection LOS: F

Intersection Capacity Utilization 104.4%

ICU Level of Service G

Analysis Period (min) 15






~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 2: Route 2A & Mass Avenue




















 ø2	 ø4
36 s	74 s
 ø6	 ø7
36 s	9 s
	 ø8
	65 s

HCM Signalized Intersection Capacity Analysis

2: Route 2A & Mass Avenue

2030 AM Peak No Build










9/23/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	140	719	25	127	641	383	10	30	54	368	54	154
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00		1.00	1.00	
Frt	1.00	1.00		1.00	0.94			0.92		1.00	0.89	
Flt Protected	0.95	1.00		0.95	1.00			0.99		0.95	1.00	
Satd. Flow (prot)	1770	1853		1770	1758			1709		1770	1656	
Flt Permitted	0.06	1.00		0.22	1.00			0.96		0.68	1.00	
Satd. Flow (perm)	115	1853		408	1758			1653		1262	1656	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	159	817	28	144	728	435	11	34	61	418	61	175
RTOR Reduction (vph)	0	1	0	0	20	0	0	44	0	0	94	0
Lane Group Flow (vph)	159	844	0	144	1143	0	0	62	0	418	142	0
Turn Type	pm+pt			Perm			Perm			Perm		
Protected Phases	7	4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	69.0	69.0		60.0	60.0			31.0		31.0	31.0	
Effective Green, g (s)	69.0	69.0		60.0	60.0			31.0		31.0	31.0	
Actuated g/C Ratio	0.63	0.63		0.55	0.55			0.28		0.28	0.28	
Clearance Time (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	132	1162		223	959			466		356	467	
v/s Ratio Prot	c0.04	0.46			0.65						0.09	
v/s Ratio Perm	c0.71			0.35				0.04		c0.33		
v/c Ratio	1.20	0.73		0.65	1.19			0.13		1.17	0.30	
Uniform Delay, d1	29.9	14.0		17.5	25.0			29.5		39.5	31.0	
Progression Factor	1.00	1.00		1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	143.5	2.3		6.3	96.9			0.1		104.0	0.4	
Delay (s)	173.4	16.3		23.8	121.9			29.6		143.5	31.4	
Level of Service	F	B		C	F			C		F	C	
Approach Delay (s)		41.2			111.1			29.6			103.1	
Approach LOS		D			F			C			F	
Intersection Summary												
HCM Average Control Delay			83.7			HCM Level of Service				F		
HCM Volume to Capacity ratio			1.17									
Actuated Cycle Length (s)			110.0			Sum of lost time (s)			10.0			
Intersection Capacity Utilization			104.4%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

Lanes, Volumes, Timings
3: Route 2A & Old Mass Ave

2030 AM Peak No Build

9/23/2013










						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	148	901	819	9	12	126
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.999		0.877	
Flt Protected		0.993			0.996	
Satd. Flow (prot)	0	1850	1861	0	1627	0
Flt Permitted		0.993			0.996	
Satd. Flow (perm)	0	1850	1861	0	1627	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		1525	1435		707	
Travel Time (s)		34.7	32.6		16.1	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	168	1024	931	10	14	143
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1192	941	0	157	0
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	117.7%			ICU Level of Service H		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis

3: Route 2A & Old Mass Ave

2030 AM Peak No Build










9/23/2013

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	148	901	819	9	12	126
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	168	1024	931	10	14	143
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	941				2296	936
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	941				2296	936
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	77				59	55
cM capacity (veh/h)	729				33	321
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	1192	941	157			
Volume Left	168	0	14			
Volume Right	0	10	143			
cSH	729	1700	182			
Volume to Capacity	0.23	0.55	0.86			
Queue Length 95th (ft)	22	0	156			
Control Delay (s)	7.3	0.0	86.1			
Lane LOS	A		F			
Approach Delay (s)	7.3	0.0	86.1			
Approach LOS			F			
Intersection Summary						
Average Delay			9.7			
Intersection Capacity Utilization		117.7%		ICU Level of Service		H
Analysis Period (min)		15				

Lanes, Volumes, Timings
4: Route 2A & Airport Road

2030 AM Peak No Build

9/23/2013










						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1050	930	1	1	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						
Flt Protected					0.950	
Satd. Flow (prot)	0	1863	1863	0	1770	0
Flt Permitted					0.950	
Satd. Flow (perm)	0	1863	1863	0	1770	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		846	1525		685	
Travel Time (s)		19.2	34.7		15.6	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	0	1193	1057	1	1	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1193	1058	0	1	0
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	65.3%			ICU Level of Service C		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis

4: Route 2A & Airport Road

2030 AM Peak No Build





















9/23/2013

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	1050	930	1	1	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	0	1193	1057	1	1	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1058				2251	1057
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1058				2251	1057
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				98	100
cM capacity (veh/h)	658				46	273
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	1193	1058	1			
Volume Left	0	0	1			
Volume Right	0	1	0			
cSH	658	1700	46			
Volume to Capacity	0.00	0.62	0.02			
Queue Length 95th (ft)	0	0	2			
Control Delay (s)	0.0	0.0	85.7			
Lane LOS			F			
Approach Delay (s)	0.0	0.0	85.7			
Approach LOS			F			
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utilization			65.3%	ICU Level of Service		C
Analysis Period (min)			15			

Lanes, Volumes, Timings
5: Old Bedford Rd & Hanscom Dr

2030 AM Peak No Build

9/23/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 						 	
Volume (vph)	37	236	0	0	22	1	150	112	0	3	25	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		230	0		0	0		0	0		230
Storage Lanes	0		0	0		0	0		0	0		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Lane Util. Factor	0.95	0.95	1.00	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.992							0.850
Flt Protected		0.991						0.973			0.996	
Satd. Flow (prot)	0	3548	0	0	3581	0	0	1849	0	0	1692	1615
Flt Permitted		0.991						0.973			0.996	
Satd. Flow (perm)	0	3548	0	0	3581	0	0	1849	0	0	1692	1615
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		592			394			514			456	
Travel Time (s)		13.5			9.0			11.7			10.4	
Peak Hour Factor	0.59	0.80	0.81	0.92	0.59	0.50	0.83	0.80	0.92	0.92	0.80	1.00
Heavy Vehicles (%)	0%	1%	2%	0%	0%	0%	0%	0%	0%	0%	13%	0%
Adj. Flow (vph)	63	295	0	0	37	2	181	140	0	3	31	3
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	358	0	0	39	0	0	321	0	0	34	3
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 38.4% ICU Level of Service A





















Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

5: Old Bedford Rd & Hanscom Dr












2030 AM Peak No Build

9/23/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 						 	
Volume (veh/h)	37	236	0	0	22	1	150	112	0	3	25	3
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.59	0.80	0.81	0.92	0.59	0.50	0.83	0.80	0.92	0.92	0.80	1.00
Hourly flow rate (vph)	63	295	0	0	37	2	181	140	0	3	31	3
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	560	539	31	687	539	140	31			140		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	560	539	31	687	539	140	31			140		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	83	26	100	100	91	100	89			100		
cM capacity (veh/h)	374	399	1043	133	400	913	1594			1456		
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1	SB 2					
Volume Total	161	197	25	14	321	35	3					
Volume Left	63	0	0	0	181	3	0					
Volume Right	0	0	0	2	0	0	3					
cSH	389	399	400	434	1594	1456	1700					
Volume to Capacity	0.41	0.49	0.06	0.03	0.11	0.00	0.00					
Queue Length 95th (ft)	50	66	5	3	10	0	0					
Control Delay (s)	20.7	22.5	14.6	13.6	4.7	0.7	0.0					
Lane LOS	C	C	B	B	A	A						
Approach Delay (s)	21.7		14.2		4.7	0.7						
Approach LOS	C		B									
Intersection Summary												
Average Delay			13.0									
Intersection Capacity Utilization			38.4%		ICU Level of Service					A		
Analysis Period (min)			15									

Lanes, Volumes, Timings
6: Route 2A & Hanscom Dr

2030 AM Peak No Build
9/23/2013

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	304	898	434	470	141	145
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	75			0	0	0
Storage Lanes	1			0	1	1
Taper Length (ft)	25			25	25	25
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.929			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1787	1863	1689	0	1671	1583
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1787	1863	1689	0	1671	1583
Link Speed (mph)		30	30		30	
Link Distance (ft)		753	771		267	
Travel Time (s)		17.1	17.5		6.1	
Peak Hour Factor	0.87	0.95	0.86	0.84	0.80	0.73
Heavy Vehicles (%)	1%	2%	4%	5%	8%	2%
Adj. Flow (vph)	349	945	505	560	176	199
Shared Lane Traffic (%)						
Lane Group Flow (vph)	349	945	1065	0	176	199
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 86.3% ICU Level of Service E












Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

6: Route 2A & Hanscom Dr

2030 AM Peak No Build










9/23/2013

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	304	898	434	470	141	145
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.87	0.95	0.86	0.84	0.80	0.73
Hourly flow rate (vph)	349	945	505	560	176	199
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	505				2429	784
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	505				2429	784
tC, single (s)	4.1				6.5	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.3
p0 queue free %	67				0	49
cM capacity (veh/h)	1065				23	393
Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2	
Volume Total	349	945	1064	176	199	
Volume Left	349	0	0	176	0	
Volume Right	0	0	560	0	199	
cSH	1065	1700	1700	23	393	
Volume to Capacity	0.33	0.56	0.63	7.78	0.51	
Queue Length 95th (ft)	36	0	0	Err	69	
Control Delay (s)	10.0	0.0	0.0	Err	23.2	
Lane LOS	B			F	C	
Approach Delay (s)	2.7		0.0	4713.3		
Approach LOS				F		
Intersection Summary						
Average Delay			647.6			
Intersection Capacity Utilization			86.3%	ICU Level of Service		E
Analysis Period (min)			15			

Lanes, Volumes, Timings
10: Virginia Rd & Old Bedford Rd

2030 AM Peak No Build

9/23/2013

						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	37	20	158	310	164	203
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.957		0.913			
Flt Protected	0.967					0.978
Satd. Flow (prot)	1723	0	1722	0	0	1838
Flt Permitted	0.967					0.978
Satd. Flow (perm)	1723	0	1722	0	0	1838
Link Speed (mph)	30		30			30
Link Distance (ft)	634		229			338
Travel Time (s)	14.4		5.2			7.7
Peak Hour Factor	0.65	0.75	0.87	0.94	0.82	0.82
Heavy Vehicles (%)	3%	0%	2%	0%	0%	2%
Adj. Flow (vph)	57	27	182	330	200	248
Shared Lane Traffic (%)						
Lane Group Flow (vph)	84	0	512	0	0	448
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 60.4% ICU Level of Service B










Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

10: Virginia Rd & Old Bedford Rd

2030 AM Peak No Build




















9/23/2013

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	37	20	158	310	164	203
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.65	0.75	0.87	0.94	0.82	0.82
Hourly flow rate (vph)	57	27	182	330	200	248
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	994	347			511	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	994	347			511	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	74	96			81	
cM capacity (veh/h)	220	701			1064	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	84	511	448			
Volume Left	57	0	200			
Volume Right	27	330	0			
cSH	281	1700	1064			
Volume to Capacity	0.30	0.30	0.19			
Queue Length 95th (ft)	30	0	17			
Control Delay (s)	23.1	0.0	5.2			
Lane LOS	C		A			
Approach Delay (s)	23.1	0.0	5.2			
Approach LOS	C					
Intersection Summary						
Average Delay			4.1			
Intersection Capacity Utilization		60.4%		ICU Level of Service		B
Analysis Period (min)		15				

Lanes, Volumes, Timings
2: Route 2A & Mass Avenue

2030 PM Peak No Build













9/23/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	139	601	13	48	729	242	19	82	128	412	48	177
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	250		0	250		0	0		0	100		0
Storage Lanes	1		0	1		0	0		0	1		0
Taper Length (ft)	25		25	25		25	25		25	25		25
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.997			0.963			0.925			0.882	
Flt Protected	0.950			0.950				0.996		0.950		
Satd. Flow (prot)	1770	1857	0	1770	1794	0	0	1716	0	1770	1643	0
Flt Permitted	0.051			0.258				0.959		0.500		
Satd. Flow (perm)	95	1857	0	481	1794	0	0	1652	0	931	1643	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			16			48			140	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1435			667			796			673	
Travel Time (s)		32.6			15.2			18.1			15.3	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	158	683	15	55	828	275	22	93	145	468	55	201
Shared Lane Traffic (%)												
Lane Group Flow (vph)	158	698	0	55	1103	0	0	260	0	468	256	0
Turn Type	pm+pt			Perm			Perm			Perm		
Protected Phases	7	4			8			2			6	
Permitted Phases	4			8			2			6		
Detector Phase	7	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	9.0	21.0		21.0	21.0		21.0	21.0		21.0	21.0	
Total Split (s)	11.0	89.0	0.0	78.0	78.0	0.0	61.0	61.0	0.0	61.0	61.0	0.0
Total Split (%)	7.3%	59.3%	0.0%	52.0%	52.0%	0.0%	40.7%	40.7%	0.0%	40.7%	40.7%	0.0%
Maximum Green (s)	6.0	84.0		73.0	73.0		56.0	56.0		56.0	56.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0
Lead/Lag	Lead			Lag	Lag							
Lead-Lag Optimize?	Yes			Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)		5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0		11.0	11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0		0	0		0	0		0	0	
Act Effect Green (s)	84.0	84.0		73.0	73.0			56.0		56.0	56.0	
Actuated g/C Ratio	0.56	0.56		0.49	0.49			0.37		0.37	0.37	
v/c Ratio	1.32	0.67		0.24	1.25			0.40		1.34	0.37	
Control Delay	216.6	27.3		25.8	156.5			30.0		210.6	16.4	
Queue Delay	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Total Delay	216.6	27.3		25.8	156.5			30.0		210.6	16.4	
LOS	F	C		C	F			C		F	B	

Lanes, Volumes, Timings
2: Route 2A & Mass Avenue

2030 PM Peak No Build

9/23/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		62.2			150.3			30.0			141.9	
Approach LOS		E			F			C			F	
Queue Length 50th (ft)	~148	466		31	~1341			152		~597	77	
Queue Length 95th (ft)	#292	588		63	#1553			225		#794	146	
Internal Link Dist (ft)		1355			587			716			593	
Turn Bay Length (ft)	250			250						100		
Base Capacity (vph)	120	1040		234	881			647		348	701	
Starvation Cap Reductn	0	0		0	0			0		0	0	
Spillback Cap Reductn	0	0		0	0			0		0	0	
Storage Cap Reductn	0	0		0	0			0		0	0	
Reduced v/c Ratio	1.32	0.67		0.24	1.25			0.40		1.34	0.37	

Intersection Summary

Area Type: Other

Cycle Length: 150

Actuated Cycle Length: 150

Natural Cycle: 140

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 1.34

Intersection Signal Delay: 112.7

Intersection LOS: F

Intersection Capacity Utilization 113.5%

ICU Level of Service H

Analysis Period (min) 15






~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 2: Route 2A & Mass Avenue




















 ø2	 ø4
61 s	89 s
 ø6	 ø7
61 s	11 s
	 ø8
	78 s

HCM Signalized Intersection Capacity Analysis

2: Route 2A & Mass Avenue










2030 PM Peak No Build

9/23/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	139	601	13	48	729	242	19	82	128	412	48	177
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00		1.00	1.00	
Flt	1.00	1.00		1.00	0.96			0.92		1.00	0.88	
Flt Protected	0.95	1.00		0.95	1.00			1.00		0.95	1.00	
Satd. Flow (prot)	1770	1857		1770	1793			1715		1770	1643	
Flt Permitted	0.05	1.00		0.26	1.00			0.96		0.50	1.00	
Satd. Flow (perm)	96	1857		481	1793			1652		931	1643	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	158	683	15	55	828	275	22	93	145	468	55	201
RTOR Reduction (vph)	0	0	0	0	8	0	0	30	0	0	88	0
Lane Group Flow (vph)	158	698	0	55	1095	0	0	230	0	468	168	0
Turn Type	pm+pt			Perm			Perm			Perm		
Protected Phases	7	4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	84.0	84.0		73.0	73.0			56.0		56.0	56.0	
Effective Green, g (s)	84.0	84.0		73.0	73.0			56.0		56.0	56.0	
Actuated g/C Ratio	0.56	0.56		0.49	0.49			0.37		0.37	0.37	
Clearance Time (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	121	1040		234	873			617		348	613	
v/s Ratio Prot	c0.05	0.38			0.61						0.10	
v/s Ratio Perm	c0.68			0.11				0.14		c0.50		
v/c Ratio	1.31	0.67		0.24	1.25			0.37		1.34	0.27	
Uniform Delay, d1	42.9	23.3		22.3	38.5			34.2		47.0	32.8	
Progression Factor	1.00	1.00		1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	184.9	1.7		0.5	123.7			0.4		173.2	0.2	
Delay (s)	227.7	25.0		22.8	162.2			34.6		220.2	33.1	
Level of Service	F	C		C	F			C		F	C	
Approach Delay (s)		62.4			155.6			34.6			154.1	
Approach LOS		E			F			C			F	
Intersection Summary												
HCM Average Control Delay			118.1			HCM Level of Service				F		
HCM Volume to Capacity ratio			1.30									
Actuated Cycle Length (s)			150.0			Sum of lost time (s)			10.0			
Intersection Capacity Utilization			113.5%			ICU Level of Service			H			
Analysis Period (min)			15									
c Critical Lane Group												

Lanes, Volumes, Timings
3: Route 2A & Old Mass Ave

2030 PM Peak No Build
9/23/2013

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	45	684	898	9	69	216
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.999		0.898	
Flt Protected		0.997			0.988	
Satd. Flow (prot)	0	1857	1861	0	1653	0
Flt Permitted		0.997			0.988	
Satd. Flow (perm)	0	1857	1861	0	1653	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		1525	1435		707	
Travel Time (s)		34.7	32.6		16.1	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	51	777	1020	10	78	245
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	828	1030	0	323	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 96.7% ICU Level of Service F










Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

3: Route 2A & Old Mass Ave










2030 PM Peak No Build

9/23/2013

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	45	684	898	9	69	216
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	51	777	1020	10	78	245
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1031				1905	1026
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1031				1905	1026
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	92				0	14
cM capacity (veh/h)	674				70	285
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	828	1031	324			
Volume Left	51	0	78			
Volume Right	0	10	245			
cSH	674	1700	163			
Volume to Capacity	0.08	0.61	1.99			
Queue Length 95th (ft)	6	0	624			
Control Delay (s)	2.1	0.0	511.0			
Lane LOS	A		F			
Approach Delay (s)	2.1	0.0	511.0			
Approach LOS			F			
Intersection Summary						
Average Delay			76.6			
Intersection Capacity Utilization			96.7%	ICU Level of Service		F
Analysis Period (min)			15			

Lanes, Volumes, Timings
4: Route 2A & Airport Road

2030 PM Peak No Build
9/23/2013










						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	721	1069	2	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						
Flt Protected						
Satd. Flow (prot)	0	1863	1863	0	1863	0
Flt Permitted						
Satd. Flow (perm)	0	1863	1863	0	1863	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		846	1525		685	
Travel Time (s)		19.2	34.7		15.6	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	0	819	1215	2	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	819	1217	0	0	0
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	59.7%			ICU Level of Service B		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis

4: Route 2A & Airport Road

2030 PM Peak No Build





















9/23/2013

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	721	1069	2	0	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	0	819	1215	2	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1217				2035	1216
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1217				2035	1216
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	573				63	221
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	819	1217	0			
Volume Left	0	0	0			
Volume Right	0	2	0			
cSH	573	1700	1700			
Volume to Capacity	0.00	0.72	0.00			
Queue Length 95th (ft)	0	0	0			
Control Delay (s)	0.0	0.0	0.0			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	0.0			
Approach LOS			A			
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utilization			59.7%	ICU Level of Service		B
Analysis Period (min)			15			

Lanes, Volumes, Timings
5: Old Bedford Rd & Hanscom Dr

2030 PM Peak No Build

9/23/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 						 	
Volume (vph)	5	23	0	0	243	4	109	30	0	3	203	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		230	0		0	0		0	0		230
Storage Lanes	0		0	0		0	0		0	0		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Lane Util. Factor	0.95	0.95	1.00	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.996							0.850
Flt Protected		0.988						0.963			0.999	
Satd. Flow (prot)	0	3567	0	0	3596	0	0	1830	0	0	1826	1615
Flt Permitted		0.988						0.963			0.999	
Satd. Flow (perm)	0	3567	0	0	3596	0	0	1830	0	0	1826	1615
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		592			394			514			456	
Travel Time (s)		13.5			9.0			11.7			10.4	
Peak Hour Factor	0.63	0.88	0.66	0.92	0.76	0.50	0.92	0.82	0.82	0.92	0.84	0.50
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	4%	0%
Adj. Flow (vph)	8	26	0	0	320	8	118	37	0	3	242	8
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	34	0	0	328	0	0	155	0	0	245	8
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 35.3%

ICU Level of Service A






















Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

5: Old Bedford Rd & Hanscom Dr

2030 PM Peak No Build












9/23/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 			 			 	
Volume (veh/h)	5	23	0	0	243	4	109	30	0	3	203	4
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.63	0.88	0.66	0.92	0.76	0.50	0.92	0.82	0.82	0.92	0.84	0.50
Hourly flow rate (vph)	8	26	0	0	320	8	118	37	0	3	242	8
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	690	522	242	535	522	37	242			37		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	690	522	242	535	522	37	242			37		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	94	94	100	100	24	99	91			100		
cM capacity (veh/h)	127	420	802	408	420	1042	1337			1587		
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1	SB 2					
Volume Total	17	17	213	115	155	245	8					
Volume Left	8	0	0	0	118	3	0					
Volume Right	0	0	0	8	0	0	8					
cSH	200	420	420	439	1337	1587	1700					
Volume to Capacity	0.08	0.04	0.51	0.26	0.09	0.00	0.00					
Queue Length 95th (ft)	7	3	70	26	7	0	0					
Control Delay (s)	24.6	13.9	22.0	16.1	6.2	0.1	0.0					
Lane LOS	C	B	C	C	A	A						
Approach Delay (s)	19.1		20.0		6.2	0.1						
Approach LOS	C		C									
Intersection Summary												
Average Delay			10.6									
Intersection Capacity Utilization			35.3%		ICU Level of Service					A		
Analysis Period (min)			15									

Lanes, Volumes, Timings
6: Route 2A & Hanscom Dr

2030 PM Peak No Build

9/23/2013

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	96	359	859	195	380	479
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	75			0	0	0
Storage Lanes	1			0	1	1
Taper Length (ft)	25			25	25	25
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.970			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1787	1845	1825	0	1787	1599
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1787	1845	1825	0	1787	1599
Link Speed (mph)		30	30		30	
Link Distance (ft)		743	582		267	
Travel Time (s)		16.9	13.2		6.1	
Peak Hour Factor	0.87	0.96	0.95	0.75	0.83	0.89
Heavy Vehicles (%)	1%	3%	1%	1%	1%	1%
Adj. Flow (vph)	110	374	904	260	458	538
Shared Lane Traffic (%)						
Lane Group Flow (vph)	110	374	1164	0	458	538
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 93.4% ICU Level of Service F












Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

6: Route 2A & Hanscom Dr

2030 PM Peak No Build










9/23/2013

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	96	359	859	195	380	479
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.87	0.96	0.95	0.75	0.83	0.89
Hourly flow rate (vph)	110	374	904	260	458	538
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	904				1629	1034
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	904				1629	1034
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	85				0	0
cM capacity (veh/h)	756				96	283
Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2	
Volume Total	110	374	1164	458	538	
Volume Left	110	0	0	458	0	
Volume Right	0	0	260	0	538	
cSH	756	1700	1700	96	283	
Volume to Capacity	0.15	0.22	0.68	4.76	1.90	
Queue Length 95th (ft)	13	0	0	Err	932	
Control Delay (s)	10.6	0.0	0.0	Err	448.3	
Lane LOS	B			F	F	
Approach Delay (s)	2.4		0.0	4838.3		
Approach LOS				F		
Intersection Summary						
Average Delay			1822.7			
Intersection Capacity Utilization			93.4%	ICU Level of Service		F
Analysis Period (min)			15			

Lanes, Volumes, Timings
10: Virginia Rd & Old Bedford Rd

2030 PM Peak No Build

9/23/2013

						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	147	235	202	77	16	144
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.918		0.952			
Flt Protected	0.981					0.994
Satd. Flow (prot)	1704	0	1778	0	0	1872
Flt Permitted	0.981					0.994
Satd. Flow (perm)	1704	0	1778	0	0	1872
Link Speed (mph)	30		30			30
Link Distance (ft)	634		229			338
Travel Time (s)	14.4		5.2			7.7
Peak Hour Factor	0.85	0.87	0.72	0.50	0.75	0.90
Heavy Vehicles (%)	1%	0%	1%	3%	0%	1%
Adj. Flow (vph)	173	270	281	154	21	160
Shared Lane Traffic (%)						
Lane Group Flow (vph)	443	0	435	0	0	181
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 50.2% ICU Level of Service A










Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

10: Virginia Rd & Old Bedford Rd

2030 PM Peak No Build

9/23/2013

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	147	235	202	77	16	144
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.85	0.87	0.72	0.50	0.75	0.90
Hourly flow rate (vph)	173	270	281	154	21	160
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	560	358			435	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	560	358			435	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	64	61			98	
cM capacity (veh/h)	482	691			1136	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	443	435	181			
Volume Left	173	0	21			
Volume Right	270	154	0			
cSH	591	1700	1136			
Volume to Capacity	0.75	0.26	0.02			
Queue Length 95th (ft)	165	0	1			
Control Delay (s)	27.1	0.0	1.1			
Lane LOS	D		A			
Approach Delay (s)	27.1	0.0	1.1			
Approach LOS	D					
Intersection Summary						
Average Delay		11.5				
Intersection Capacity Utilization		50.2%		ICU Level of Service		A
Analysis Period (min)		15				




















Appendix C-9

SYNCHRO LOS Analysis: 2030 Build

Lanes, Volumes, Timings
2: Route 2A & Mass Avenue

2030 AM Peak













9/23/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	145	736	25	127	681	383	10	30	54	368	54	164
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	250		0	250		0	0		0	100		0
Storage Lanes	1		0	1		0	0		0	1		0
Taper Length (ft)	25		25	25		25	25		25	25		25
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.995			0.946			0.922			0.887	
Flt Protected	0.950			0.950				0.995		0.950		
Satd. Flow (prot)	1770	1853	0	1770	1762	0	0	1709	0	1770	1652	0
Flt Permitted	0.062			0.206				0.961		0.678		
Satd. Flow (perm)	115	1853	0	384	1762	0	0	1650	0	1263	1652	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		3			40			61			139	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1435			667			796			673	
Travel Time (s)		32.6			15.2			18.1			15.3	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	165	836	28	144	774	435	11	34	61	418	61	186
Shared Lane Traffic (%)												
Lane Group Flow (vph)	165	864	0	144	1209	0	0	106	0	418	247	0
Turn Type	pm+pt			Perm			Perm			Perm		
Protected Phases	7	4			8			2			6	
Permitted Phases	4			8			2			6		
Detector Phase	7	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	9.0	21.0		21.0	21.0		21.0	21.0		21.0	21.0	
Total Split (s)	9.0	74.0	0.0	65.0	65.0	0.0	36.0	36.0	0.0	36.0	36.0	0.0
Total Split (%)	8.2%	67.3%	0.0%	59.1%	59.1%	0.0%	32.7%	32.7%	0.0%	32.7%	32.7%	0.0%
Maximum Green (s)	4.0	69.0		60.0	60.0		31.0	31.0		31.0	31.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0
Lead/Lag	Lead			Lag	Lag							
Lead-Lag Optimize?	Yes			Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)		5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0		11.0	11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0		0	0		0	0		0	0	
Act Effect Green (s)	69.0	69.0		60.0	60.0			31.0		31.0	31.0	
Actuated g/C Ratio	0.63	0.63		0.55	0.55			0.28		0.28	0.28	
v/c Ratio	1.25	0.74		0.69	1.23			0.21		1.17	0.44	
Control Delay	181.3	19.3		38.6	139.6			15.4		140.6	16.5	
Queue Delay	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Total Delay	181.3	19.3		38.6	139.6			15.4		140.6	16.5	
LOS	F	B		D	F			B		F	B	

Lanes, Volumes, Timings
2: Route 2A & Mass Avenue

2030 AM Peak

9/23/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		45.2			128.9			15.4			94.5	
Approach LOS		D			F			B			F	
Queue Length 50th (ft)	~68	392		70	~1052			23		~354	59	
Queue Length 95th (ft)	#172	531		#179	#1267			65		#529	127	
Internal Link Dist (ft)		1355			587			716			593	
Turn Bay Length (ft)	250			250						100		
Base Capacity (vph)	132	1163		209	979			509		356	565	
Starvation Cap Reductn	0	0		0	0			0		0	0	
Spillback Cap Reductn	0	0		0	0			0		0	0	
Storage Cap Reductn	0	0		0	0			0		0	0	
Reduced v/c Ratio	1.25	0.74		0.69	1.23			0.21		1.17	0.44	

Intersection Summary

Area Type: Other

Cycle Length: 110

Actuated Cycle Length: 110

Natural Cycle: 110

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 1.25

Intersection Signal Delay: 90.5

Intersection LOS: F

Intersection Capacity Utilization 106.8%

ICU Level of Service G

Analysis Period (min) 15






~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 2: Route 2A & Mass Avenue





















 ø2	 ø4
36 s	74 s
 ø6	 ø7
36 s	9 s
	 ø8
	65 s

HCM Signalized Intersection Capacity Analysis

2: Route 2A & Mass Avenue










2030 AM Peak

9/23/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	145	736	25	127	681	383	10	30	54	368	54	164
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00		1.00	1.00	
Frt	1.00	1.00		1.00	0.95			0.92		1.00	0.89	
Flt Protected	0.95	1.00		0.95	1.00			0.99		0.95	1.00	
Satd. Flow (prot)	1770	1854		1770	1762			1709		1770	1652	
Flt Permitted	0.06	1.00		0.21	1.00			0.96		0.68	1.00	
Satd. Flow (perm)	115	1854		384	1762			1652		1262	1652	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	165	836	28	144	774	435	11	34	61	418	61	186
RTOR Reduction (vph)	0	1	0	0	18	0	0	44	0	0	100	0
Lane Group Flow (vph)	165	863	0	144	1191	0	0	62	0	418	147	0
Turn Type	pm+pt			Perm			Perm			Perm		
Protected Phases	7	4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	69.0	69.0		60.0	60.0			31.0		31.0	31.0	
Effective Green, g (s)	69.0	69.0		60.0	60.0			31.0		31.0	31.0	
Actuated g/C Ratio	0.63	0.63		0.55	0.55			0.28		0.28	0.28	
Clearance Time (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	132	1163		209	961			466		356	466	
v/s Ratio Prot	c0.05	0.47			0.68						0.09	
v/s Ratio Perm	c0.74			0.37				0.04		c0.33		
v/c Ratio	1.25	0.74		0.69	1.24			0.13		1.17	0.32	
Uniform Delay, d1	29.9	14.3		18.2	25.0			29.5		39.5	31.1	
Progression Factor	1.00	1.00		1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	160.3	2.6		9.1	116.6			0.1		104.0	0.4	
Delay (s)	190.2	16.9		27.3	141.6			29.6		143.5	31.5	
Level of Service	F	B		C	F			C		F	C	
Approach Delay (s)		44.7			129.4			29.6			101.9	
Approach LOS		D			F			C			F	
Intersection Summary												
HCM Average Control Delay			92.6			HCM Level of Service				F		
HCM Volume to Capacity ratio			1.20									
Actuated Cycle Length (s)			110.0			Sum of lost time (s)			10.0			
Intersection Capacity Utilization			106.8%			ICU Level of Service			G			
Analysis Period (min)			15									
c Critical Lane Group												

Lanes, Volumes, Timings
3: Route 2A & Old Mass Ave

2030 AM Peak
9/23/2013

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	148	922	870	9	12	126
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.999		0.877	
Flt Protected		0.993			0.996	
Satd. Flow (prot)	0	1850	1861	0	1627	0
Flt Permitted		0.993			0.996	
Satd. Flow (perm)	0	1850	1861	0	1627	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		1525	1435		707	
Travel Time (s)		34.7	32.6		16.1	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	168	1048	989	10	14	143
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1216	999	0	157	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized










Intersection Capacity Utilization 121.5% ICU Level of Service H

Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis










3: Route 2A & Old Mass Ave

2030 AM Peak
9/23/2013

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	148	922	870	9	12	126
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	168	1048	989	10	14	143
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	999				2378	994
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	999				2378	994
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	76				53	52
cM capacity (veh/h)	693				29	298
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	1216	999	157			
Volume Left	168	0	14			
Volume Right	0	10	143			
cSH	693	1700	164			
Volume to Capacity	0.24	0.59	0.96			
Queue Length 95th (ft)	24	0	181			
Control Delay (s)	8.1	0.0	114.6			
Lane LOS	A		F			
Approach Delay (s)	8.1	0.0	114.6			
Approach LOS			F			
Intersection Summary						
Average Delay		11.7				
Intersection Capacity Utilization		121.5%		ICU Level of Service		H
Analysis Period (min)		15				

Lanes, Volumes, Timings
4: Route 2A & Airport Road










2030 AM Peak
9/23/2013

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1076	990	1	1	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						
Flt Protected					0.950	
Satd. Flow (prot)	0	1863	1863	0	1770	0
Flt Permitted					0.950	
Satd. Flow (perm)	0	1863	1863	0	1770	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		846	1525		685	
Travel Time (s)		19.2	34.7		15.6	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	0	1223	1125	1	1	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1223	1126	0	1	0
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	66.6%			ICU Level of Service C		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis






















4: Route 2A & Airport Road

2030 AM Peak
9/23/2013

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	1076	990	1	1	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	0	1223	1125	1	1	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1126				2348	1126
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1126				2348	1126
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				97	100
cM capacity (veh/h)	620				40	249
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	1223	1126	1			
Volume Left	0	0	1			
Volume Right	0	1	0			
cSH	620	1700	40			
Volume to Capacity	0.00	0.66	0.03			
Queue Length 95th (ft)	0	0	2			
Control Delay (s)	0.0	0.0	98.5			
Lane LOS			F			
Approach Delay (s)	0.0	0.0	98.5			
Approach LOS			F			
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utilization		66.6%		ICU Level of Service		C
Analysis Period (min)		15				

Lanes, Volumes, Timings
5: Old Bedford Rd & Hanscom Dr

2030 AM Peak
9/23/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 			 			 	
Volume (vph)	75	236	0	0	22	1	150	224	0	10	80	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		230	0		0	0		0	0		230
Storage Lanes	0		0	0		0	0		0	0		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Lane Util. Factor	0.95	0.95	1.00	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.992							0.850
Flt Protected		0.985						0.981			0.995	
Satd. Flow (prot)	0	3531	0	0	3581	0	0	1864	0	0	1692	1615
Flt Permitted		0.985						0.981			0.995	
Satd. Flow (perm)	0	3531	0	0	3581	0	0	1864	0	0	1692	1615
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		592			394			514			456	
Travel Time (s)		13.5			9.0			11.7			10.4	
Peak Hour Factor	0.59	0.80	0.81	0.92	0.59	0.50	0.83	0.80	0.92	0.92	0.80	1.00
Heavy Vehicles (%)	0%	1%	2%	0%	0%	0%	0%	0%	0%	0%	13%	0%
Adj. Flow (vph)	127	295	0	0	37	2	181	280	0	11	100	10
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	422	0	0	39	0	0	461	0	0	111	10
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 45.4% ICU Level of Service A





















Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

5: Old Bedford Rd & Hanscom Dr












2030 AM Peak

9/23/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 						 	
Volume (veh/h)	75	236	0	0	22	1	150	224	0	10	80	10
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.59	0.80	0.81	0.92	0.59	0.50	0.83	0.80	0.92	0.92	0.80	1.00
Hourly flow rate (vph)	127	295	0	0	37	2	181	280	0	11	100	10
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	784	763	100	911	763	280	100			280		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	784	763	100	911	763	280	100			280		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	50	0	100	0	87	100	88			99		
cM capacity (veh/h)	255	293	956	0	294	764	1505			1294		
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1	SB 2					
Volume Total	225	197	25	14	461	111	10					
Volume Left	127	0	0	0	181	11	0					
Volume Right	0	0	0	2	0	0	10					
cSH	270	293	294	321	1505	1294	1700					
Volume to Capacity	0.83	0.67	0.08	0.04	0.12	0.01	0.01					
Queue Length 95th (ft)	170	112	7	4	10	1	0					
Control Delay (s)	61.0	39.3	18.4	16.7	3.7	0.8	0.0					
Lane LOS	F	E	C	C	A	A						
Approach Delay (s)	50.9		17.8		3.7	0.8						
Approach LOS	F		C									
Intersection Summary												
Average Delay			23.0									
Intersection Capacity Utilization			45.4%		ICU Level of Service					A		
Analysis Period (min)			15									

Lanes, Volumes, Timings
6: Route 2A & Hanscom Dr

2030 AM Peak
9/23/2013

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	356	898	434	530	167	173
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	75			0	0	0
Storage Lanes	1			0	1	1
Taper Length (ft)	25			25	25	25
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.925			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1787	1863	1681	0	1671	1583
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1787	1863	1681	0	1671	1583
Link Speed (mph)		30	30		30	
Link Distance (ft)		753	771		267	
Travel Time (s)		17.1	17.5		6.1	
Peak Hour Factor	0.87	0.95	0.86	0.84	0.80	0.73
Heavy Vehicles (%)	1%	2%	4%	5%	8%	2%
Adj. Flow (vph)	409	945	505	631	209	237
Shared Lane Traffic (%)						
Lane Group Flow (vph)	409	945	1136	0	209	237
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized












Intersection Capacity Utilization 94.3% ICU Level of Service F

Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis










6: Route 2A & Hanscom Dr

2030 AM Peak
9/23/2013

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	356	898	434	530	167	173
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.87	0.95	0.86	0.84	0.80	0.73
Hourly flow rate (vph)	409	945	505	631	209	237
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	505				2584	820
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	505				2584	820
tC, single (s)	4.1				6.5	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.6	3.3
p0 queue free %	62				0	37
cM capacity (veh/h)	1065				16	375
Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2	
Volume Total	409	945	1136	209	237	
Volume Left	409	0	0	209	0	
Volume Right	0	0	631	0	237	
cSH	1065	1700	1700	16	375	
Volume to Capacity	0.38	0.56	0.67	12.67	0.63	
Queue Length 95th (ft)	46	0	0	Err	104	
Control Delay (s)	10.5	0.0	0.0	Err	29.7	
Lane LOS	B			F	D	
Approach Delay (s)	3.2		0.0	4698.6		
Approach LOS				F		
Intersection Summary						
Average Delay			714.8			
Intersection Capacity Utilization			94.3%	ICU Level of Service		F
Analysis Period (min)			15			

Lanes, Volumes, Timings
10: Virginia Rd & Old Bedford Rd

2030 AM Peak
9/23/2013

						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	41	24	158	333	179	203
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.955		0.911			
Flt Protected	0.968					0.977
Satd. Flow (prot)	1722	0	1719	0	0	1837
Flt Permitted	0.968					0.977
Satd. Flow (perm)	1722	0	1719	0	0	1837
Link Speed (mph)	30		30			30
Link Distance (ft)	634		229			338
Travel Time (s)	14.4		5.2			7.7
Peak Hour Factor	0.65	0.75	0.87	0.94	0.82	0.82
Heavy Vehicles (%)	3%	0%	2%	0%	0%	2%
Adj. Flow (vph)	63	32	182	354	218	248
Shared Lane Traffic (%)						
Lane Group Flow (vph)	95	0	536	0	0	466
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other

Control Type: Unsignalized










Intersection Capacity Utilization 63.1% ICU Level of Service B

Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

10: Virginia Rd & Old Bedford Rd




















2030 AM Peak
9/23/2013

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	41	24	158	333	179	203
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.65	0.75	0.87	0.94	0.82	0.82
Hourly flow rate (vph)	63	32	182	354	218	248
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1043	359			536	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1043	359			536	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	68	95			79	
cM capacity (veh/h)	200	690			1042	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	95	536	466			
Volume Left	63	0	218			
Volume Right	32	354	0			
cSH	263	1700	1042			
Volume to Capacity	0.36	0.32	0.21			
Queue Length 95th (ft)	40	0	20			
Control Delay (s)	26.3	0.0	5.6			
Lane LOS	D		A			
Approach Delay (s)	26.3	0.0	5.6			
Approach LOS	D					
Intersection Summary						
Average Delay			4.7			
Intersection Capacity Utilization		63.1%		ICU Level of Service		B
Analysis Period (min)		15				

Lanes, Volumes, Timings
2: Route 2A & Mass Avenue

2030 PM Peak













9/23/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	149	639	13	48	756	242	19	82	128	412	48	183
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	250		0	250		0	0		0	100		0
Storage Lanes	1		0	1		0	0		0	1		0
Taper Length (ft)	25		25	25		25	25		25	25		25
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.997			0.964			0.925			0.881	
Flt Protected	0.950			0.950				0.996		0.950		
Satd. Flow (prot)	1770	1857	0	1770	1796	0	0	1716	0	1770	1641	0
Flt Permitted	0.051			0.225				0.958		0.500		
Satd. Flow (perm)	95	1857	0	419	1796	0	0	1651	0	931	1641	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			15			48			145	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1435			667			796			673	
Travel Time (s)		32.6			15.2			18.1			15.3	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	169	726	15	55	859	275	22	93	145	468	55	208
Shared Lane Traffic (%)												
Lane Group Flow (vph)	169	741	0	55	1134	0	0	260	0	468	263	0
Turn Type	pm+pt			Perm			Perm			Perm		
Protected Phases	7	4			8			2			6	
Permitted Phases	4			8			2			6		
Detector Phase	7	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	9.0	21.0		21.0	21.0		21.0	21.0		21.0	21.0	
Total Split (s)	11.0	89.0	0.0	78.0	78.0	0.0	61.0	61.0	0.0	61.0	61.0	0.0
Total Split (%)	7.3%	59.3%	0.0%	52.0%	52.0%	0.0%	40.7%	40.7%	0.0%	40.7%	40.7%	0.0%
Maximum Green (s)	6.0	84.0		73.0	73.0		56.0	56.0		56.0	56.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0
Lead/Lag	Lead			Lag	Lag							
Lead-Lag Optimize?	Yes			Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		None	None		None	None	
Walk Time (s)		5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0		11.0	11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0		0	0		0	0		0	0	
Act Effect Green (s)	84.0	84.0		73.0	73.0			56.0		56.0	56.0	
Actuated g/C Ratio	0.56	0.56		0.49	0.49			0.37		0.37	0.37	
v/c Ratio	1.41	0.71		0.27	1.29			0.40		1.34	0.37	
Control Delay	252.1	28.9		27.3	170.4			30.0		210.6	16.3	
Queue Delay	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Total Delay	252.1	28.9		27.3	170.4			30.0		210.6	16.3	
LOS	F	C		C	F			C		F	B	

Lanes, Volumes, Timings
2: Route 2A & Mass Avenue

2030 PM Peak

9/23/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		70.4			163.8			30.0			140.7	
Approach LOS		E			F			C			F	
Queue Length 50th (ft)	~171	513		31	~1405			152		~597	79	
Queue Length 95th (ft)	#319	645		66	#1615			225		#794	149	
Internal Link Dist (ft)		1355			587			716			593	
Turn Bay Length (ft)	250			250						100		
Base Capacity (vph)	120	1040		204	882			646		348	704	
Starvation Cap Reductn	0	0		0	0			0		0	0	
Spillback Cap Reductn	0	0		0	0			0		0	0	
Storage Cap Reductn	0	0		0	0			0		0	0	
Reduced v/c Ratio	1.41	0.71		0.27	1.29			0.40		1.34	0.37	

Intersection Summary

Area Type: Other

Cycle Length: 150

Actuated Cycle Length: 150

Natural Cycle: 120

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 1.41

Intersection Signal Delay: 119.6

Intersection LOS: F

Intersection Capacity Utilization 115.5%

ICU Level of Service H

Analysis Period (min) 15






~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 2: Route 2A & Mass Avenue




















 ø2	 ø4
61 s	89 s
 ø6	 ø7
61 s	11 s
	 ø8
	78 s

HCM Signalized Intersection Capacity Analysis

2: Route 2A & Mass Avenue










2030 PM Peak

9/23/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	149	639	13	48	756	242	19	82	128	412	48	183
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00		1.00	1.00	
Flt	1.00	1.00		1.00	0.96			0.92		1.00	0.88	
Flt Protected	0.95	1.00		0.95	1.00			1.00		0.95	1.00	
Satd. Flow (prot)	1770	1857		1770	1795			1715		1770	1642	
Flt Permitted	0.05	1.00		0.23	1.00			0.96		0.50	1.00	
Satd. Flow (perm)	96	1857		420	1795			1651		931	1642	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	169	726	15	55	859	275	22	93	145	468	55	208
RTOR Reduction (vph)	0	0	0	0	8	0	0	30	0	0	91	0
Lane Group Flow (vph)	169	741	0	55	1126	0	0	230	0	468	172	0
Turn Type	pm+pt			Perm			Perm			Perm		
Protected Phases	7	4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	84.0	84.0		73.0	73.0			56.0		56.0	56.0	
Effective Green, g (s)	84.0	84.0		73.0	73.0			56.0		56.0	56.0	
Actuated g/C Ratio	0.56	0.56		0.49	0.49			0.37		0.37	0.37	
Clearance Time (s)	5.0	5.0		5.0	5.0			5.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	121	1040		204	874			616		348	613	
v/s Ratio Prot	c0.06	0.40			0.63						0.10	
v/s Ratio Perm	c0.73			0.13				0.14		c0.50		
v/c Ratio	1.40	0.71		0.27	1.29			0.37		1.34	0.28	
Uniform Delay, d1	42.9	24.2		22.7	38.5			34.2		47.0	32.9	
Progression Factor	1.00	1.00		1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2	220.8	2.3		0.7	138.5			0.4		173.2	0.3	
Delay (s)	263.7	26.5		23.5	177.0			34.6		220.2	33.2	
Level of Service	F	C		C	F			C		F	C	
Approach Delay (s)		70.5			169.9			34.6			152.9	
Approach LOS		E			F			C			F	
Intersection Summary												
HCM Average Control Delay			125.2			HCM Level of Service				F		
HCM Volume to Capacity ratio			1.35									
Actuated Cycle Length (s)			150.0			Sum of lost time (s)			10.0			
Intersection Capacity Utilization			115.5%			ICU Level of Service			H			
Analysis Period (min)			15									
c Critical Lane Group												

Lanes, Volumes, Timings
3: Route 2A & Old Mass Ave

2030 PM Peak
9/23/2013

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	45	734	932	9	69	216
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.999		0.898	
Flt Protected		0.997			0.988	
Satd. Flow (prot)	0	1857	1861	0	1653	0
Flt Permitted		0.997			0.988	
Satd. Flow (perm)	0	1857	1861	0	1653	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		1525	1435		707	
Travel Time (s)		34.7	32.6		16.1	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	51	834	1059	10	78	245
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	885	1069	0	323	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized










Intersection Capacity Utilization 99.3% ICU Level of Service F

Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis










3: Route 2A & Old Mass Ave

2030 PM Peak
9/23/2013

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	45	734	932	9	69	216
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	51	834	1059	10	78	245
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1069				2001	1064
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1069				2001	1064
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	92				0	9
cM capacity (veh/h)	652				61	271
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	885	1069	324			
Volume Left	51	0	78			
Volume Right	0	10	245			
cSH	652	1700	147			
Volume to Capacity	0.08	0.63	2.20			
Queue Length 95th (ft)	6	0	666			
Control Delay (s)	2.2	0.0	611.2			
Lane LOS	A		F			
Approach Delay (s)	2.2	0.0	611.2			
Approach LOS			F			
Intersection Summary						
Average Delay			87.7			
Intersection Capacity Utilization			99.3%	ICU Level of Service		F
Analysis Period (min)			15			

Lanes, Volumes, Timings
4: Route 2A & Airport Road










2030 PM Peak
9/23/2013

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	772	1110	2	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						
Flt Protected						
Satd. Flow (prot)	0	1863	1863	0	1863	0
Flt Permitted						
Satd. Flow (perm)	0	1863	1863	0	1863	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		846	1525		685	
Travel Time (s)		19.2	34.7		15.6	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	0	877	1261	2	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	877	1263	0	0	0
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type: Unsignalized						
Intersection Capacity Utilization 61.9%				ICU Level of Service B		
Analysis Period (min) 15						

HCM Unsignalized Intersection Capacity Analysis






















4: Route 2A & Airport Road

2030 PM Peak
9/23/2013

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	772	1110	2	0	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	0	877	1261	2	0	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1264				2140	1262
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1264				2140	1262
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	550				54	207
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	877	1264	0			
Volume Left	0	0	0			
Volume Right	0	2	0			
cSH	550	1700	1700			
Volume to Capacity	0.00	0.74	0.00			
Queue Length 95th (ft)	0	0	0			
Control Delay (s)	0.0	0.0	0.0			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	0.0			
Approach LOS			A			
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utilization		61.9%		ICU Level of Service		B
Analysis Period (min)		15				

Lanes, Volumes, Timings
5: Old Bedford Rd & Hanscom Dr

2030 PM Peak
9/23/2013

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 			 			 	
Volume (vph)	16	23	0	0	243	8	109	94	0	8	203	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		230	0		0	0		0	0		230
Storage Lanes	0		0	0		0	0		0	0		1
Taper Length (ft)	25		25	25		25	25		25	25		25
Lane Util. Factor	0.95	0.95	1.00	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.993							0.850
Flt Protected		0.976						0.975			0.998	
Satd. Flow (prot)	0	3523	0	0	3585	0	0	1852	0	0	1826	1615
Flt Permitted		0.976						0.975			0.998	
Satd. Flow (perm)	0	3523	0	0	3585	0	0	1852	0	0	1826	1615
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		592			394			514			456	
Travel Time (s)		13.5			9.0			11.7			10.4	
Peak Hour Factor	0.63	0.88	0.66	0.92	0.76	0.50	0.92	0.82	0.82	0.92	0.84	0.50
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	4%	0%
Adj. Flow (vph)	25	26	0	0	320	16	118	115	0	9	242	22
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	51	0	0	336	0	0	233	0	0	251	22
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 45.7%






















ICU Level of Service A

Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis












5: Old Bedford Rd & Hanscom Dr

2030 PM Peak
9/23/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 			 			 	
Volume (veh/h)	16	23	0	0	243	8	109	94	0	8	203	11
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.63	0.88	0.66	0.92	0.76	0.50	0.92	0.82	0.82	0.92	0.84	0.50
Hourly flow rate (vph)	25	26	0	0	320	16	118	115	0	9	242	22
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	787	611	242	624	611	115	242			115		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	787	611	242	624	611	115	242			115		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	68	93	100	100	14	98	91			99		
cM capacity (veh/h)	79	373	802	352	373	943	1337			1487		
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1	SB 2					
Volume Total	34	17	213	123	233	250	22					
Volume Left	25	0	0	0	118	9	0					
Volume Right	0	0	0	16	0	0	22					
cSH	99	373	373	405	1337	1487	1700					
Volume to Capacity	0.34	0.05	0.57	0.30	0.09	0.01	0.01					
Queue Length 95th (ft)	34	4	85	31	7	0	0					
Control Delay (s)	59.3	15.1	26.8	17.7	4.4	0.3	0.0					
Lane LOS	F	C	D	C	A	A						
Approach Delay (s)	44.3		23.5		4.4	0.3						
Approach LOS	E		C									
Intersection Summary												
Average Delay			12.6									
Intersection Capacity Utilization			45.7%		ICU Level of Service					A		
Analysis Period (min)			15									

Lanes, Volumes, Timings
6: Route 2A & Hanscom Dr

2030 PM Peak
9/23/2013

						
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	120	359	859	236	431	552
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	75			0	0	0
Storage Lanes	1			0	1	1
Taper Length (ft)	25			25	25	25
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.965			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1787	1845	1815	0	1787	1599
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1787	1845	1815	0	1787	1599
Link Speed (mph)		30	30		30	
Link Distance (ft)		743	582		267	
Travel Time (s)		16.9	13.2		6.1	
Peak Hour Factor	0.87	0.96	0.95	0.75	0.83	0.89
Heavy Vehicles (%)	1%	3%	1%	1%	1%	1%
Adj. Flow (vph)	138	374	904	315	519	620
Shared Lane Traffic (%)						
Lane Group Flow (vph)	138	374	1219	0	519	620
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized












Intersection Capacity Utilization 100.4% ICU Level of Service G

Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis










6: Route 2A & Hanscom Dr

2030 PM Peak
9/23/2013

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	120	359	859	236	431	552
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.87	0.96	0.95	0.75	0.83	0.89
Hourly flow rate (vph)	138	374	904	315	519	620
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	904				1711	1062
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	904				1711	1062
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	82				0	0
cM capacity (veh/h)	756				82	273
Direction, Lane #	EB 1	EB 2	WB 1	SB 1	SB 2	
Volume Total	138	374	1219	519	620	
Volume Left	138	0	0	519	0	
Volume Right	0	0	315	0	620	
cSH	756	1700	1700	82	273	
Volume to Capacity	0.18	0.22	0.72	6.34	2.27	
Queue Length 95th (ft)	17	0	0	Err	1206	
Control Delay (s)	10.8	0.0	0.0	Err	613.3	
Lane LOS	B			F	F	
Approach Delay (s)	2.9		0.0	4890.4		
Approach LOS				F		
Intersection Summary						
Average Delay			1942.0			
Intersection Capacity Utilization			100.4%	ICU Level of Service		G
Analysis Period (min)			15			

Lanes, Volumes, Timings
10: Virginia Rd & Old Bedford Rd

2030 PM Peak
9/23/2013

						
Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	147	235	202	77	27	144
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.918		0.952			
Flt Protected	0.981					0.991
Satd. Flow (prot)	1704	0	1778	0	0	1868
Flt Permitted	0.981					0.991
Satd. Flow (perm)	1704	0	1778	0	0	1868
Link Speed (mph)	30		30			30
Link Distance (ft)	634		229			338
Travel Time (s)	14.4		5.2			7.7
Peak Hour Factor	0.85	0.87	0.72	0.50	0.75	0.90
Heavy Vehicles (%)	1%	0%	1%	3%	0%	1%
Adj. Flow (vph)	173	270	281	154	36	160
Shared Lane Traffic (%)						
Lane Group Flow (vph)	443	0	435	0	0	196
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other

Control Type: Unsignalized










Intersection Capacity Utilization 57.0% ICU Level of Service B

Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

10: Virginia Rd & Old Bedford Rd

2030 PM Peak
9/23/2013

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	147	235	202	77	27	144
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.85	0.87	0.72	0.50	0.75	0.90
Hourly flow rate (vph)	173	270	281	154	36	160
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	590	358			435	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	590	358			435	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	62	61			97	
cM capacity (veh/h)	457	691			1136	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	443	435	196			
Volume Left	173	0	36			
Volume Right	270	154	0			
cSH	576	1700	1136			
Volume to Capacity	0.77	0.26	0.03			
Queue Length 95th (ft)	176	0	2			
Control Delay (s)	29.0	0.0	1.8			
Lane LOS	D		A			
Approach Delay (s)	29.0	0.0	1.8			
Approach LOS	D					
Intersection Summary						
Average Delay		12.3				
Intersection Capacity Utilization		57.0%		ICU Level of Service		B
Analysis Period (min)		15				

Appendix C-10

SYNCHRO Peak Roundabout Analysis: 2030 Build

Intersection								
Intersection Delay, s/veh	11.4							
Intersection LOS	B							
Approach	EB		WB		NB		SB	
Entry Lanes	2		2		1		1	
Conflicting Circle Lanes	1		1		1		1	
Adj Approach Flow, veh/h	422		39		461		121	
Demand Flow Rate, veh/h	425		39		461		134	
Vehicles Circulating, veh/h	124		588		436		218	
Vehicles Exiting, veh/h	218		309		113		409	
Follow-Up Headway, s	3.186		3.186		3.186		3.186	
Ped Vol Crossing Leg, #/h	0		0		0		0	
Ped Cap Adj	1.000		1.000		1.000		1.000	
Approach Delay, s/veh	8.4		6.4		16.1		5.7	
Approach LOS	A		A		C		A	
Lane	Left	Bypass	Left	Right	Left	Left	Left	Bypass
Designated Moves	LT	R	LT	R	LT		LT	R
Assumed Moves	LT	R	LT	R	LT		LT	R
RT Channelized		Yield						Yield
Lane Util	1.000		0.949	0.051	1.000		1.000	
Critical Headway, s	5.193		5.193	5.193	5.193		5.193	
Entry Flow, veh/h	425	0	37	2	461		124	10
Cap Entry Lane, veh/h	998	1009	628	628	731		909	909
Entry HV Adj Factor	0.993	0.980	1.000	1.000	1.000		0.895	1.000
Flow Entry, veh/h	422	0	37	2	461		111	10
Cap Entry, veh/h	991	989	628	628	731		813	909
V/C Ratio	0.426	0.000	0.059	0.003	0.631		0.136	0.011
Control Delay, s/veh	8.4	3.6	6.4	5.8	16.1		5.8	4.1
LOS	A	A	A	A	C		A	A
95th %tile Queue, veh	2	0	0	0	5		0	0

Intersection								
Intersection Delay, s/veh	7.6							
Intersection LOS	A							
Approach	EB		WB		NB		SB	
Entry Lanes	2		2		1		1	
Conflicting Circle Lanes	1		1		1		1	
Adj Approach Flow, veh/h	51		336		233		273	
Demand Flow Rate, veh/h	51		336		233		283	
Vehicles Circulating, veh/h	261		258		60		438	
Vehicles Exiting, veh/h	438		35		252		156	
Follow-Up Headway, s	3.186		3.186		3.186		3.186	
Ped Vol Crossing Leg, #/h	0		0		0		0	
Ped Cap Adj	1.000		1.000		1.000		1.000	
Approach Delay, s/veh	4.7		8.1		5.4		9.4	
Approach LOS	A		A		A		A	
Lane	Left	Bypass	Left	Right	Left	Left	Left	Bypass
Designated Moves	LT	R	LT	R	LT		LT	R
Assumed Moves	LT	R	LT	R	LT		LT	R
RT Channelized		Yield						Yield
Lane Util	1.000		0.952	0.048	1.000		1.000	
Critical Headway, s	5.193		5.193	5.193	5.193		5.193	
Entry Flow, veh/h	51	0	320	16	233		261	22
Cap Entry Lane, veh/h	870	878	873	873	1064		729	729
Entry HV Adj Factor	1.000	1.000	1.000	1.000	1.000		0.963	1.000
Flow Entry, veh/h	51	0	320	16	233		251	22
Cap Entry, veh/h	870	878	873	873	1064		702	729
V/C Ratio	0.059	0.000	0.367	0.018	0.219		0.358	0.030
Control Delay, s/veh	4.7	4.1	8.3	4.3	5.4		9.7	5.2
LOS	A	A	A	A	A		A	A
95th %tile Queue, veh	0	0	2	0	1		2	0

Appendix C-11

2006-2010 MassDOT Crash Worksheets

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Lincoln COUNT DATE : _____

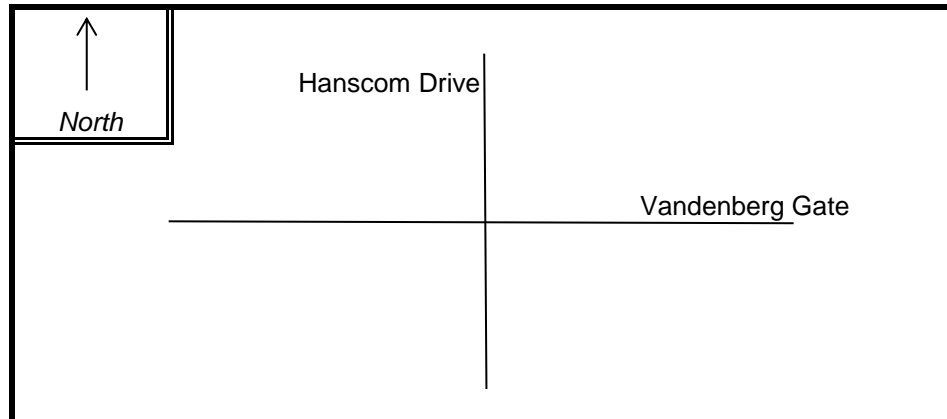
DISTRICT : _____ UNSIGNALIZED : ☒ SIGNALIZED : ☐

~ INTERSECTION DATA ~

MAJOR STREET : Hanscom Drive

MINOR STREET(S) : Old Bedford Road

**INTERSECTION
DIAGRAM**
(Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	NB	SB	EB	WB		
PEAK HOURLY VOLUMES (AM/PM) :	133	23	365	645		1,166

" K " FACTOR :

0.100

INTERSECTION ADT (V) = TOTAL DAILY APPROACH VOLUME :

11,660

TOTAL # OF CRASHES :

2

OF YEARS :

5

AVERAGE # OF CRASHES PER YEAR (A) :

0.40

CRASH RATE CALCULATION :

0.09

$$\text{RATE} = \frac{(A * 1,000,000)}{(V * 365)}$$

Comments : _____

Project Title & Date: _____

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Lincoln COUNT DATE : 2006-2010

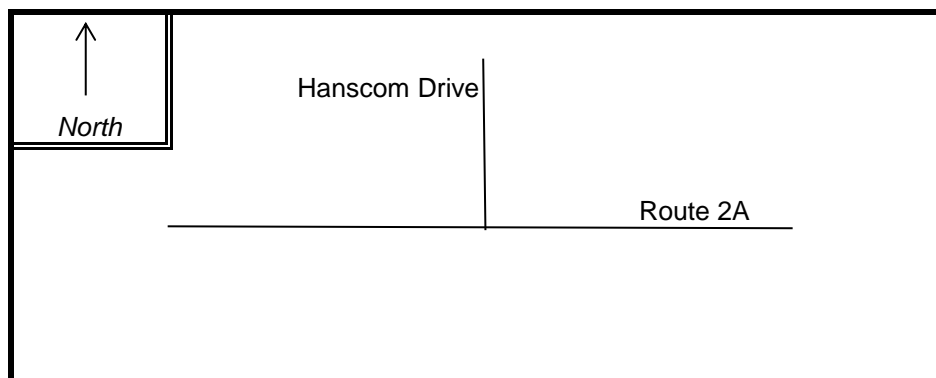
DISTRICT : _____ UNSIGNALIZED : ☒ SIGNALIZED : ☐

~ INTERSECTION DATA ~

MAJOR STREET : Hanscom Drive

MINOR STREET(S) : Route 2A

**INTERSECTION
DIAGRAM**
(Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	SB	EB	WB			
PEAK HOURLY VOLUMES (AM/PM) :	251	1,066	768			2,085

" K " FACTOR : INTERSECTION ADT (V) = TOTAL DAILY APPROACH VOLUME :

TOTAL # OF CRASHES : # OF YEARS : AVERAGE # OF CRASHES PER YEAR (A) :

CRASH RATE CALCULATION :

$$\text{RATE} = \frac{(A * 1,000,000)}{(V * 365)}$$

Comments : _____

Project Title & Date: _____

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Concord COUNT DATE : 2006-2010

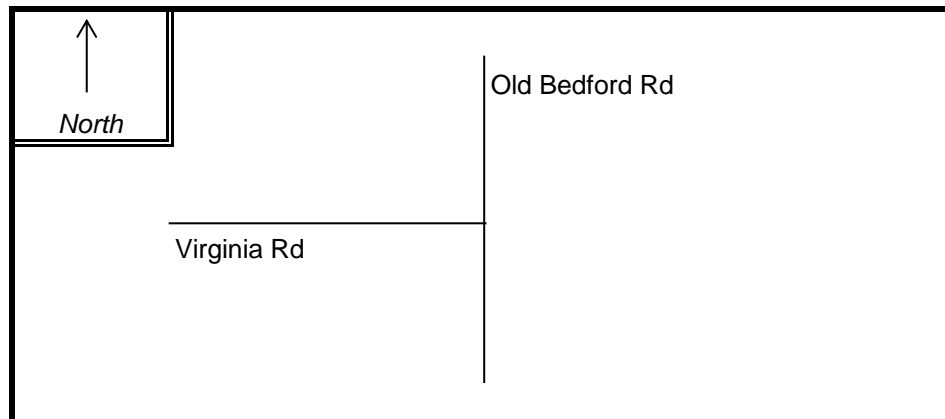
DISTRICT : _____ UNSIGNALIZED : ☒ SIGNALIZED : ☐

~ INTERSECTION DATA ~

MAJOR STREET : Old Bedford Rd

MINOR STREET(S) : Virginia Road

**INTERSECTION
DIAGRAM**
(Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	SB	WB	NB			
PEAK HOURLY VOLUMES (AM/PM) :	331	52	401			784

" K " FACTOR :

0.100

INTERSECTION ADT (V) = TOTAL DAILY APPROACH VOLUME :

7,840

TOTAL # OF CRASHES :

2

OF YEARS :

5

AVERAGE # OF CRASHES PER YEAR (A) :

0.40

CRASH RATE CALCULATION :

0.14

$$\text{RATE} = \frac{(A * 1,000,000)}{(V * 365)}$$

Comments : _____

Project Title & Date: _____

Appendix C-12

Trip Generation Estimates

	Morning Peak Hour			Afternoon Peak Hour		
2005 ESPR Existing Trip Generation						
	In	Out	Total	In	Out	Total
General Aviation	48	16	64	30	46	76
Commercial	5	5	10	4	1	5
Other	62	21	83	41	32	73
TOTAL	115	42	157	75	79	154
2012 ESPR Existing Trip Generation						
	In	Out	Total	In	Out	Total
General Aviation	48	16	64	30	46	76
Commercial	0	0	0	0	0	0
Other	88	13	101	7	38	45
TOTAL	136	29	165	37	84	121
2020 Forecast Trip Generation						
	In	Out	Total	In	Out	Total
General Aviation	48	16	64	30	46	76
Commercial	6	6	12	5	1	6
Other	102	15	117	8	44	52
Museum (50%)	22	5	27	3	29	32
TOTAL	178	42	220	46	120	166
2030 Forecast Trip Generation						
	In	Out	Total	In	Out	Total
General Aviation	55	18	73	34	53	87
Commercial	11	11	22	9	2	11
Other	118	17	135	9	51	60
Museum (100%)	44	10	54	6	58	64
Hotel	59	41	101	58	56	114
TOTAL	287	97	385	116	220	336

Appendix D Noise

Appendix D Noise

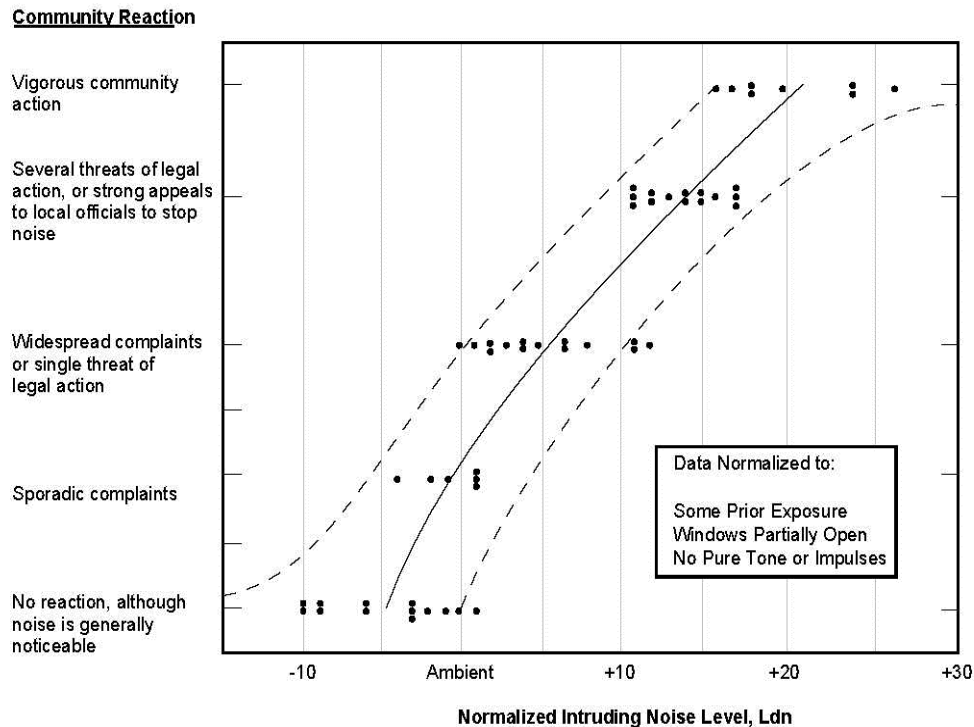


Figure D-1 Community Reaction as a Function of Outdoor Noise Level

D.1 Noise Effects

This section addresses the primary ways people are affected by aircraft noise: annoyance, sleep disturbance, and speech interference.

D.1.1 Annoyance

Social survey data have long made it clear that individual reactions to noise vary widely for a given noise level. Nevertheless, as a group, people's aggregate response to factors such as speech and sleep interference and desire for an acceptable environment is predictable and relates well to measures of cumulative noise exposure such as DNL. A wide variety of responses have been investigated in social survey research. The concept of "percent highly annoyed" in sample populations seems to provide the most consistent response of a community to a particular noise source (see Figure D-1).

The most widely recognized relationship between noise and annoyance – regardless of the noise source – was developed by Schultz in the late 1970s. This relationship or the "Schultz Curve" is shown on the following page (see Figure D-2). Schultz based his analysis on data from 18 surveys conducted worldwide; the curve indicates that at levels as low as DNL 55, approximately five percent of the people will still be highly annoyed, with the percentage increasing more rapidly as exposure increases above

DNL 65¹. Separate work by the EPA has shown that overall community reaction to a noise environment is also dependent on DNL².

The most recent analysis of community annoyance (1989) supports the conclusions set forth by Schultz; that is, that the DNL-%HA relationship presented in the "Schultz curve" is applicable to all transportation noise. This analysis included Schultz' original data (161 points) and added to it data from more recent social surveys (269 points). A logistic regression of the relationship is shown in Figure D-3. This is the preferred relationship for current investigations³. The more recent analysis also showed that communities near airports are slightly more willing to describe themselves as annoyed than those near surface transportation noise sources, although there are no statistically significant differences between modes of transportation⁴.

D.1.2 Speech Interference

One of the primary effects of aircraft noise is its tendency to drown out or "mask" speech, making it difficult or impossible to carry on a normal conversation without interruption. The sound level of speech decreases as distance between a talker and listener increases. As the level of speech decreases in the presence of background noise, it becomes harder and harder to hear. Figure D-4 presents typical distances between talker and listener for satisfactory outdoor conversations in the presence of different steady A-weighted background noise levels for three degrees of vocal effort: raised, normal, and relaxed⁵. As the background level increases, the talker must raise his/her voice, or the individuals must get closer together to continue their conversation.

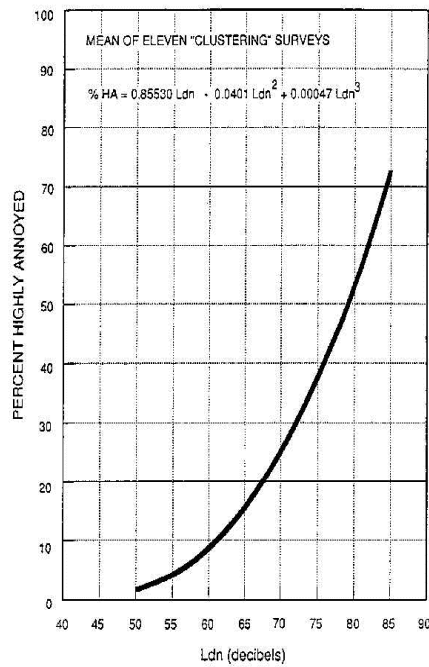
¹Schultz, T.J., "Synthesis of Social Surveys on Noise Annoyance", Journal of the Acoustical Society of America, Vol. 64, No. 2, August 1978.

²Wyle Labs, Community Noise, DOT Report NTID300.3, December, 1971.

³FICON 1992. Federal Interagency Committee on Noise, Federal Agency Review of Selected Airport Noise Analysis Issues, August, 1992.

⁴Fidell, S., Barber, D., and Schultz., Updating a Dosage-Effect Relationship for the Prevalence of Annoyance Due to General Transportation Noise, HSD-TR-89-009, Wright-Patterson AFB, Ohio: US Air Force, Noise and Sonic Boom Impact Technology.

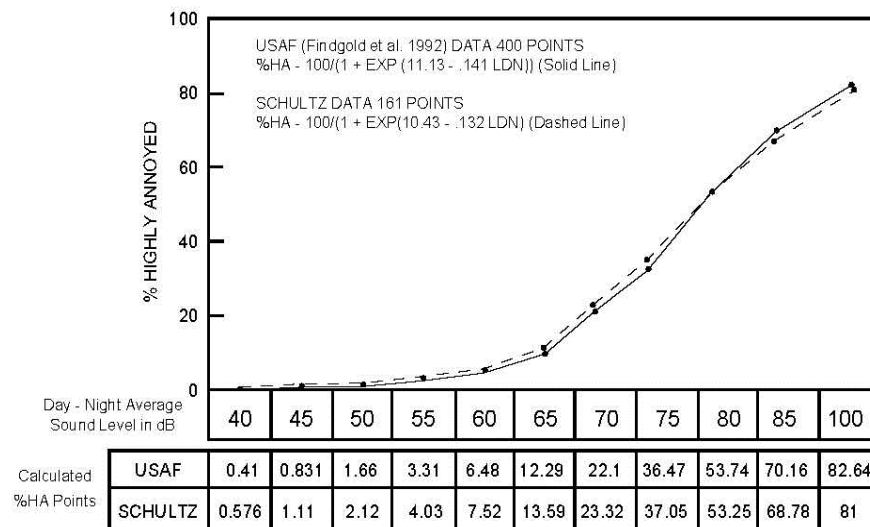
⁵United States Environmental Protection Agency, Public Health and Welfare Criteria for Noise, 1973.



Source: Schultz, 1978.

Figure D-2 Percentage of People Highly Annoyed as a Function of Exposure

As indicated in Figure D-4, satisfactory conversation does not always require hearing every word; 95 percent intelligibility is acceptable for many conversations. This is because a few unheard words can be inferred when they occur in a familiar context. However, in relaxed conversation, we have higher expectations of hearing speech and require complete 100 percent intelligibility. Any combination of talker-listener distances and background noise that falls below the bottom line in the figure represents an ideal environment for outdoor speech communication and is considered necessary for acceptable indoor conversation as well.



Source: (USAF, 1992)

Figure D-3 Comparison of Schultz Data (1978) and USAF Data (1992) on Annoyance

One implication of the relationships in the figure is that for typical communication distances of three or four feet (one to one and one-half meters), acceptable outdoor conversations where 95 percent intelligibility is acceptable can be carried on in a normal voice as long as the background noise outdoors is less than about 65 dB(A). If 100 percent intelligibility is desired, the interior background level must be less than about 45 dB(A). If the noise exceeds either of these levels, as might occur when an aircraft passes overhead, intelligibility is lost unless vocal effort is increased or communication distance decreased.

D.1.3 Sleep Interference

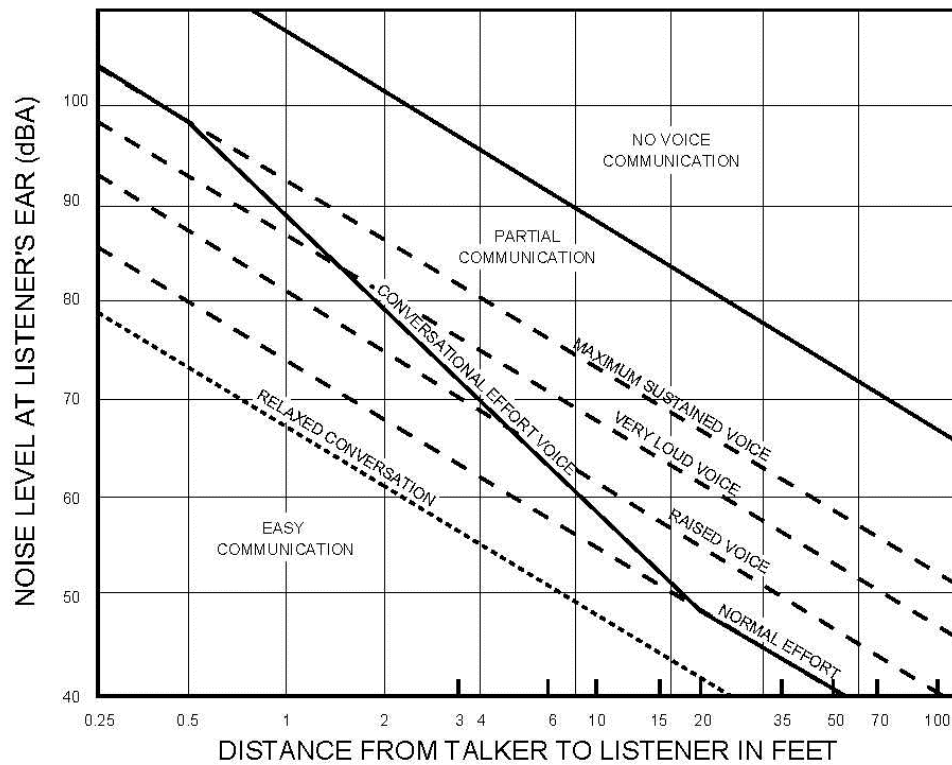
The effect of aviation noise on sleep is a long-recognized concern of those interested in addressing the impacts of noise on people. Historical studies of sleep disturbance were conducted mainly in laboratories, using various indicators of response (electroencephalographic recordings, verbal response, button push, etc.). Field studies also were conducted, in which subjects were exposed to noise in their own homes, using real or simulated noise. However, in a 1989 assessment of existing research, Pearsons indicated the need for substantially more work in this area, citing the large discrepancy between laboratory and field studies as a major concern.

In 1992, the Federal Interagency Committee on Noise (FICON) recommended an interim dose-response curve to predict the percent of the exposed population expected to be awakened (percent awakening) as a function of the exposure to single event noise levels expressed in terms of sound exposure level (SEL)⁶. This interim curve was based on the data presented in the 1989 study. The FICON report also recommended continued research into community reactions to aircraft noise, including sleep disturbance.

Since the adoption of FICON's interim curve in 1992, substantial field research in the area of sleep disturbance was conducted, using a variety of test methods, and in a number of locations. The data from these studies show a consistent pattern, with considerably less percent of the exposed population expected to be behaviorally awakened than had been shown with laboratory studies. In 1997, FICAN recommended a new dose-response curve for predicting awakening, based on the results of the field studies described above⁷. This curve is presented in Figure D-5. Because the curve represents the upper limit of the data, it should be interpreted as predicting the "maximum percent of the exposed population expected to be behaviorally awakened", or the "maximum % awakened". The dose-response relationship presented here relies on behavioral awakening as the indicator of sleep disturbance; relationships between aircraft noise and other potential sleep disturbance or related health effects responses have not been established by any of these newer studies. This curve should be applied only to long-term residential settings and should not be generalized to include children.

⁶FICON 1992.

⁷FICAN 1997. Federal Interagency Committee on Aviation Noise (FICAN) Effects of Aviation Noise on Awakenings from Sleep, June 1997.



Source: U.S. EPA, 1973

Figure D-4 Distances at Which Ordinary Speech Can be Understood

The finding on the relationship between aircraft noise and sleep disturbance does not call into question the nighttime penalty applied to Day Night Sound Level (DNL). The 10 dB penalty added to noise levels for the period 10:00 p.m. to 7:00 a.m. is intended to account for the increased intrusiveness of noise at night. The ambient is generally lower and more people are at home during this period than at other times of the day. Thus, the opportunities for activity interference are much higher during nighttime, which could lead to greater annoyance.

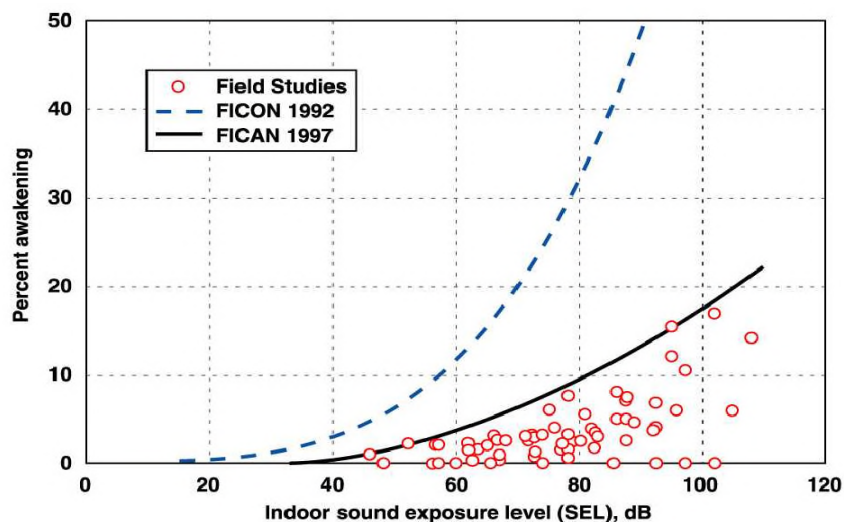


Figure D-5 Recommended Sleep Disturbance Dose-Response Relationship

D.2 Noise Prediction Methodology

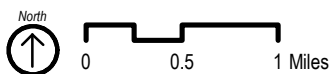
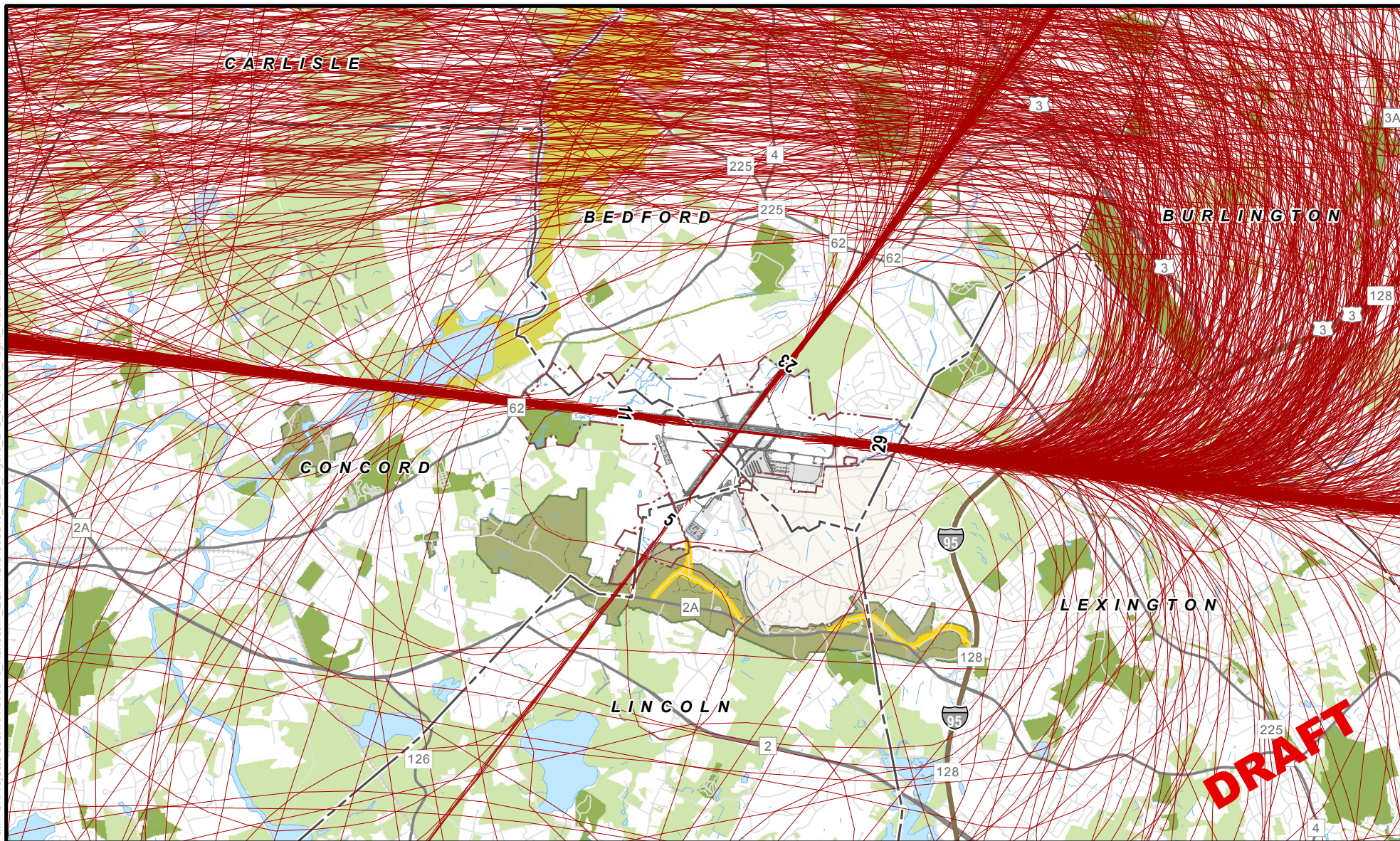
This section provides supplemental information on the noise prediction methodology described in Chapter 7. It specifically addresses the process used to develop INM flight tracks from radar data.

D.2.1 Flight Tracks

As described in section 7.4.1.2, RealContours was used to prepare the modeling input for INM. This allowed the use of over 70,000 individual radar tracks in the modeling. Figure 7-4 through Figure 7-8 display density plots for all of the flight tracks used in the modeling. The following figures display samples of the flight tracks used in the modeling. For clarity approximately 20% of the tracks used in the modeling are displayed.

Figure D-6 and Figure D-7 present a sample of the arrival and departure tracks for jet aircraft. Figure D-8 and Figure D-9 present representative tracks for arrivals and departures by propeller aircraft, including helicopters. Figure D-10 presents representative radar tracks for piston aircraft touch-and-go operations.

Path: G:\Projects\305540_Hanscom_ESPR\GIS\305540_BED_Figure D-6 Jet ARR Flight_Tracks.mxd



- | | | | | | |
|--|---------------------------------|--|---------------------|--|------------------------------------|
| | Hanscom Field Property Boundary | | Historic Road | | MNP Boundary |
| | Hanscom AFB Property Boundary | | Interstate | | Great Meadows |
| | Municipal Boundary | | Highway | | Open Space Non-protected |
| | Jet Arrival Flight Tracks | | Road | | Open Space Protected in Perpetuity |
| | | | Trail | | Open Water |
| | | | Active Rail Service | | Stream |

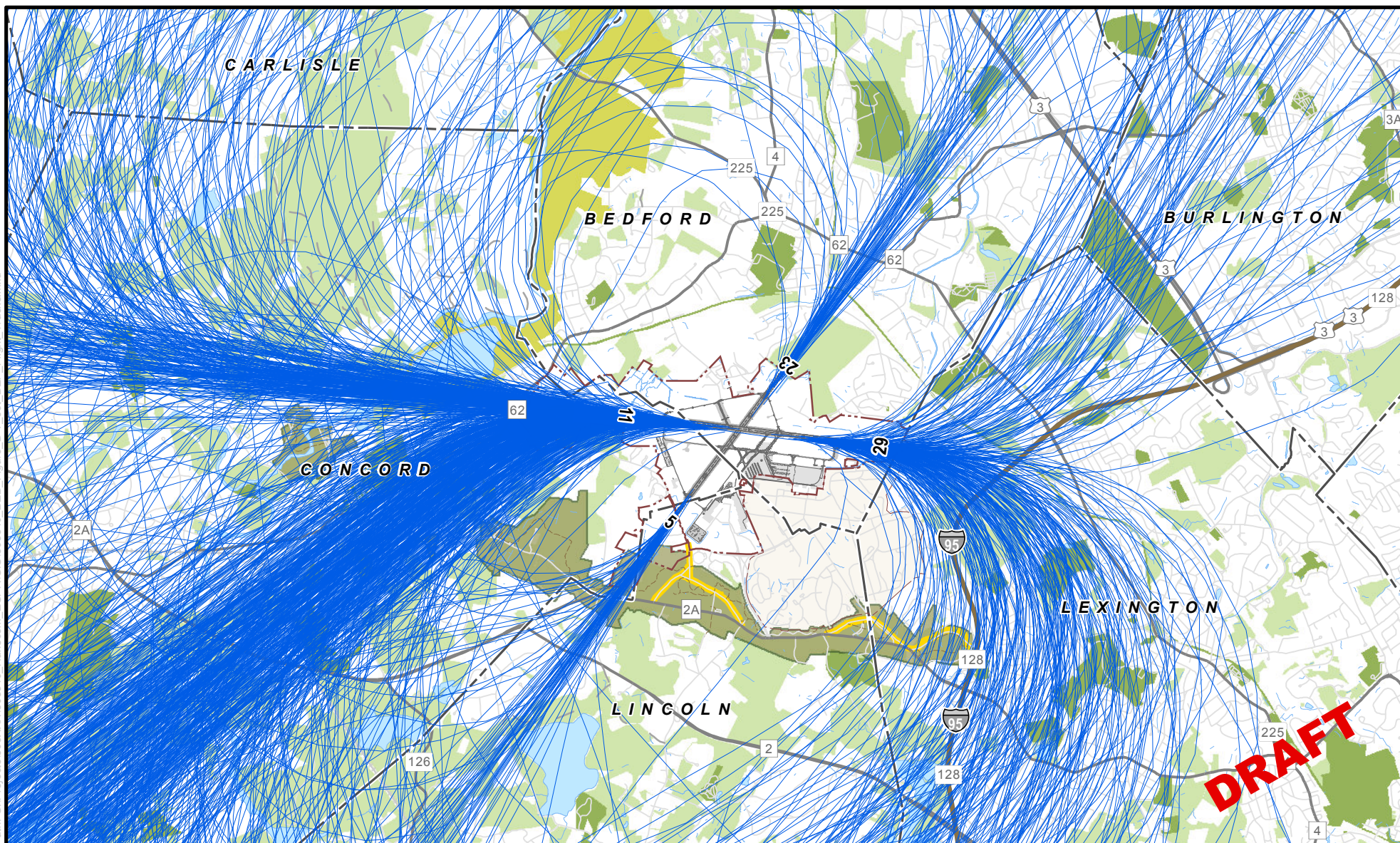


Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts
 Representative Jet Arrival Flight Tracks

Data Sources: MassGIS (Roads, Rail), March 5, 2013; MassGIS (Bike Trails, Tracks and Trails), March 7, 2013;
 MassGIS (Community Boundaries), March 5, 2013; MassGIS (DEP Wetlands), March 8, 2013;
 NPS (Park Boundary), March 8, 2013; NPS (Streets and Trails), March 8, 2013; MassGIS (Building Footprints), March 7, 2013

Figure D-6

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- | | | | | | |
|--|---------------------------------|--|---------------------|--|------------------------------------|
| | Hanscom Field Property Boundary | | Historic Road | | MNP Boundary |
| | Hanscom AFB Property Boundary | | Interstate | | Great Meadows |
| | Municipal Boundary | | Highway | | Open Space Non-protected |
| | Jet Departure Flight Tracks | | Road | | Open Space Protected in Perpetuity |
| | | | Trail | | Open Water |
| | | | Active Rail Service | | Stream |

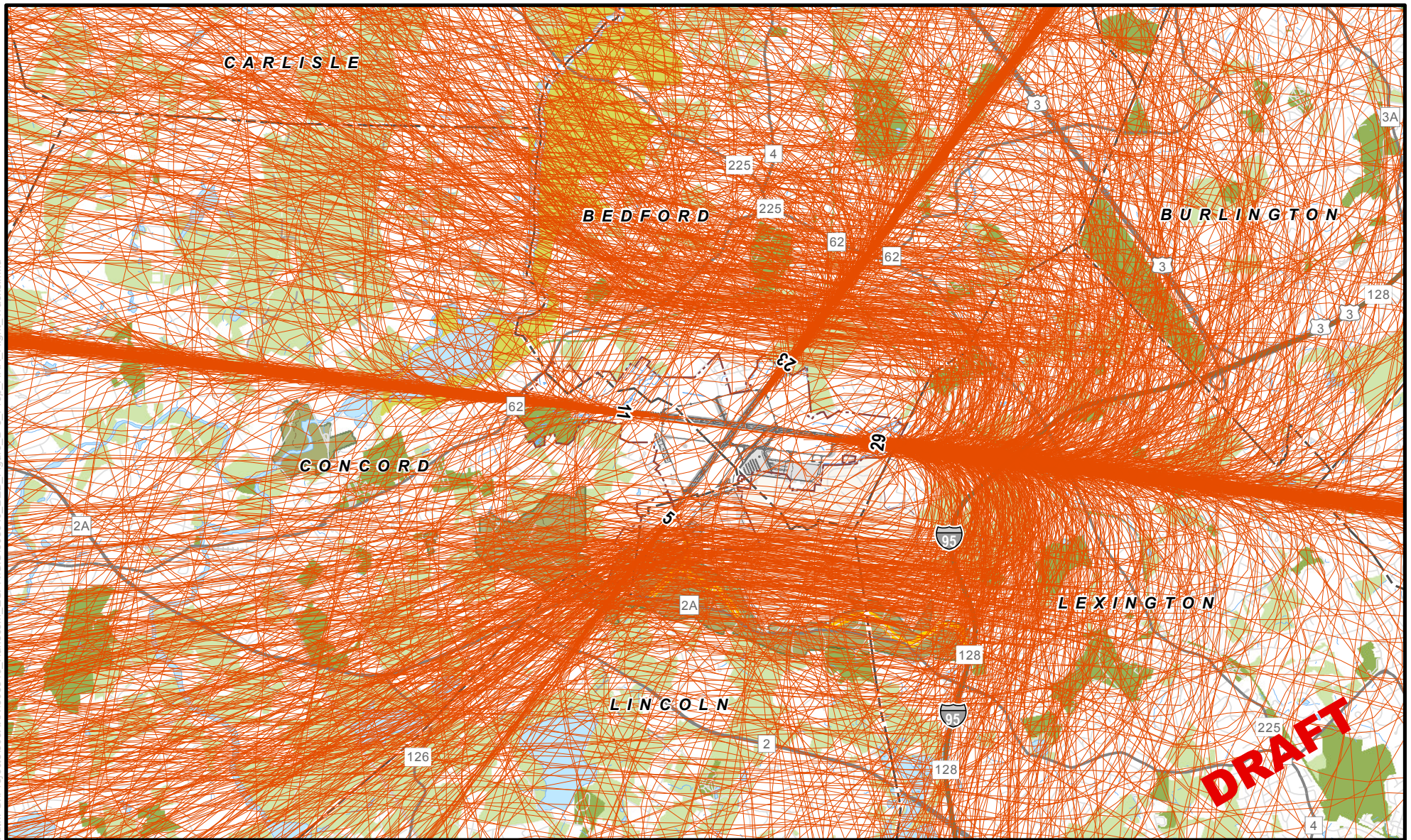


Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts
 Representative Jet Departure Flight Tracks

Data Sources: MassGIS (Roads, Rail), March 5, 2013; MassGIS (Bike Trails, Tracks and Trails), March 7, 2013;
 MassGIS (Community Boundaries), March 5, 2013; MassGIS (DEP Wetlands), March 8, 2013;
 NPS (Park Boundary), March 8, 2013; NPS (Streets and Trails), March 8, 2013; MassGIS (Building Footprints), March 7, 2013

Figure D-7

Path: G:\Projects\305XXX\305540_Hanscom_ESPR\GIS\305540_BED_Figure D-8_Prop_ARR_Flight_Tracks.mxd



- Hanscom Field Property Boundary
- Hanscom AFB Property Boundary
- Municipal Boundary
- Propeller Arrival Flight Tracks

- Historic Road
- Interstate
- Highway
- Road
- Trail
- Active Rail Service

- MNP Boundary
- Great Meadows
- Open Space Non-protected
- Open Space Protected in Perpetuity
- Open Water
- Stream

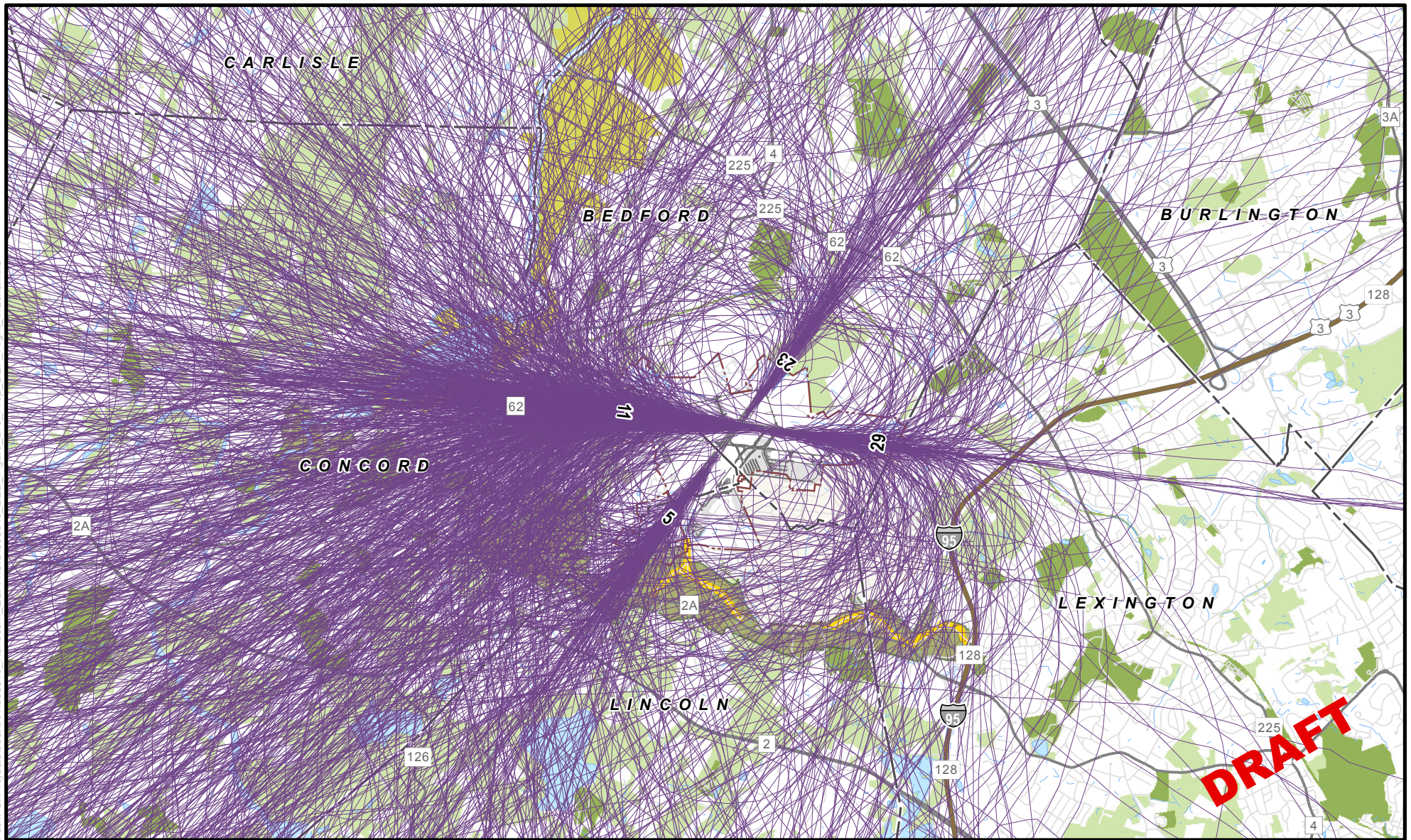


Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts
Representative Propeller Arrival Flight Tracks

Data Sources: MassGIS (Roads, Rail), March 5, 2013; MassGIS (Bike Trails, Tracks and Trails), March 7, 2013;
 MassGIS (Community Boundaries), March 5, 2013; MassGIS (DEP Wetlands), March 8, 2013;
 NPS (Park Boundary), March 8, 2013; NPS (Streets and Trails), March 8, 2013; MassGIS (Building Footprints), March 7, 2013

Figure D-8

Path: G:\Projects\3055540_Hanscom_ESPR\GIS\3055540_BED_Figure_D-9_Prop_Dep_Flight_Tracks.mxd



- Hanscom Field Property Boundary
- Hanscom AFB Property Boundary
- Municipal Boundary
- Propeller Departure Flight Tracks

- Historic Road
- Interstate
- Highway
- Road
- Trail
- Active Rail Service

- MNP Boundary
- Great Meadows
- Open Space Non-protected
- Open Space Protected in Perpetuity
- Open Water
- Stream

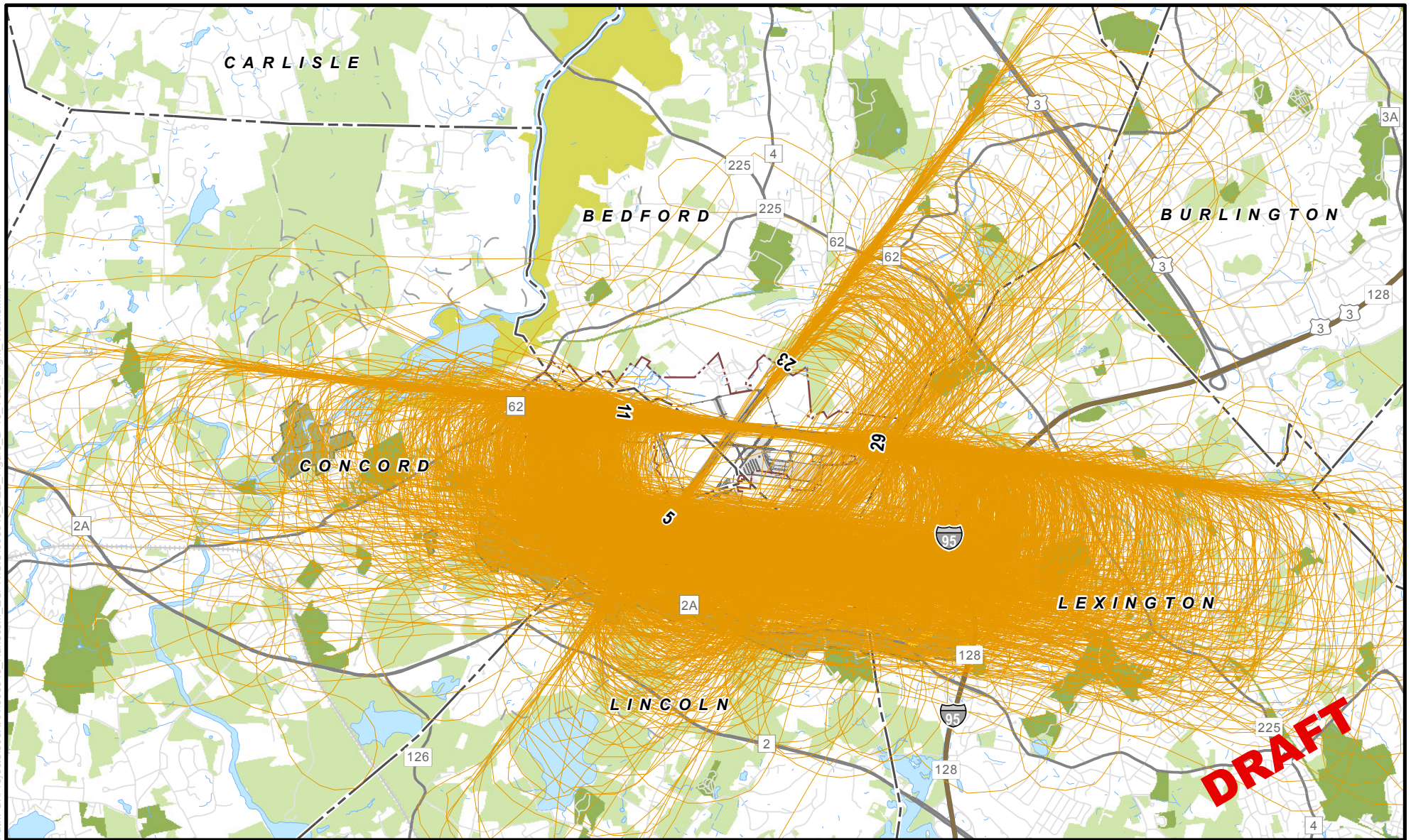


Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts
 Representative Propeller Departure Flight Tracks

Data Sources: MassGIS (Roads, Rail), March 5, 2013; MassGIS (Bike Trails, Tracks and Trails), March 7, 2013; MassGIS (Community Boundaries), March 5, 2013; MassGIS (DEP Wetlands), March 8, 2013; NPS (Park Boundary), March 8, 2013; NPS (Streets and Trails), March 8, 2013; MassGIS (Building Footprints), March 7, 2013

Figure D-9

Path: G:\Projects\305540\Hanscom_ESPR\GIS\305540_BED_Figure D-10_T&G_Flight_Tracks.mxd



- Hanscom Field Property Boundary
- Hanscom AFB Property Boundary
- Municipal Boundary
- Touch and Go Flight Tracks

- Historic Road
- Interstate
- Highway
- Road
- Trail
- Active Rail Service

- MNP Boundary
- Great Meadows
- Open Space Non-protected
- Open Space Protected in Perpetuity
- Open Water
- Stream



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts
Representative Touch and Go Flight Tracks

Data Sources: MassGIS (Roads, Rail), March 5, 2013; MassGIS (Bike Trails, Tracks and Trails), March 7, 2013;
MassGIS (Community Boundaries), March 5, 2013; MassGIS (DEP Wetlands), March 8, 2013;
NPS (Park Boundary), March 8, 2013; NPS (Streets and Trails), March 8, 2013; MassGIS (Building Footprints), March 7, 2013

Figure D-10

D.3 Detailed Operations Tables

Table D-1 through present the average daily operations for 2012 and the two future scenarios. The operations are organized by INM aircraft type.

Table D-1 Year 2012 Average Daily Operations

Aircraft Type/Group		INM ¹ TYPE	Departures		Arrivals		Total
			Day	Night	Day	Night	
Civil:							
1	Cessna 550, 500	CNA500	0.65	0.03	0.62	0.05	1.36
2	Beechjet 400	MU3001	1.93	0.11	1.94	0.10	4.08
3	Lear 31, 35, 40, 45 ,55 ,60, Hawker Siddely 125-700, -800, - 1000, Sabreliner 65, Falcon 10, Beechcraft Premier 1	LEAR35	5.37	0.32	5.20	0.49	11.39
5	Lear 24, 25, Hawker Siddely 125-400, -600	LEAR25	0.05	0.01	0.05	0.01	0.10
7	Gulfstream III	GIIB	0.09	0.01	0.10	0.00	0.20
8	Gulfstream IV, 450	GIV	3.62	0.28	3.47	0.43	7.80
9	Challenger 600, Falcon 2000, IAI Galaxy, Embraer 135, Dornier 328J	CL600	2.52	0.10	2.45	0.17	5.25
10	Challenger 601, 604, 300, Falcon 200, Canadair RJ	CL601	4.42	0.22	4.13	0.51	9.27
11	Boeing 747, 767, Unknown/Misc. Jets	74710Q	0.01	0.02	0.01	0.01	0.04
14	Douglas DC-9	DC93LW	0.08	0.02	0.07	0.04	0.21
17	Helicopters	SA365N	9.96	0.19	9.92	0.23	20.30
18	Gulfstream I	HS748A	0.00	0.00	0.00	0.00	0.01
19	Dash-6, Beech 350, 1900, Embraer 120	DHC6	2.53	0.02	2.52	0.03	5.10
20	Twin Engine Piston Prop	BEC58P	4.97	0.11	4.97	0.12	10.17
21	Single Engine Piston Prop	SEPMIX ²	172.08	0.38	171.80	0.67	344.92
22	Westwind/ Astra 1124, 1125	IA1125	0.50	0.03	0.49	0.04	1.06
25	Cessna 650	CIT3	0.16	0.01	0.16	0.01	0.34
26	Falcon 50/900	F10062	1.83	0.08	1.80	0.11	3.83
29	Cessna 441, Beech King Air 90, 100, 200	CNA441	0.93	0.06	0.94	0.05	1.98
30	Saab 340	SF340	0.00	0.00	0.00	0.00	0.01
32	Boeing 727	727EM2	0.00	0.00	0.00	0.00	0.01
33	Piaggio 180, Shorts 330	SD330	0.92	0.04	0.90	0.05	1.91
34	Boeing 737-200	737N17	0.07	0.00	0.05	0.01	0.13
35	Dornier 328, de Havilland DHC-8	DO328	0.02	0.00	0.02	0.00	0.05
36	Airbus 319, 320	A320-211	0.02	0.00	0.02	0.01	0.04
37	Gulfstream V, 550, Global Express	GV	2.00	0.12	1.89	0.23	4.23
39	Gulfstream II	GII	0.03	0.00	0.04	0.00	0.07
40	Cessna 750	CNA750	1.95	0.08	1.89	0.13	4.05
41	Boeing 737-800, 737-400	737800	0.17	0.08	0.14	0.11	0.51
42	Boeing 757	757RR	0.02	0.01	0.02	0.00	0.04
43	Eclipse 500	ECLIPSE500	1.53	0.08	1.45	0.17	3.23
44	Cessna 525	CNA525C	1.11	0.03	1.11	0.03	2.28
45	Cessna 560	CNA560U	1.05	0.02	1.05	0.03	2.16
46	Cessna 560XL	CNA560XL	2.76	0.12	2.73	0.15	5.77
47	Lear 60, Cessna 510, Embraer Phenom	CNA55B	1.04	0.05	1.04	0.05	2.19
48	Cessna 680	CNA680	1.17	0.07	1.17	0.07	2.48
Subtotal Civil Operations			225.57	2.72	224.16	4.13	456.57
Military:							
3	Falcon 200	CL601	0.07	0.00	0.07	0.00	0.15
15	Boeing 707	707QN	0.02	0.00	0.02	0.00	0.05
20	Twin Engine Piston Prop	BEC58P	0.01	0.00	0.01	0.00	0.02
21	Single Engine Piston Prop	SEPMIX	0.20	0.00	0.20	0.00	0.40
Subtotal Military Operations			0.31	0.00	0.30	0.01	0.62

Draft 2012 Environmental Status & Planning Report

Total Operations:	225.88	2.72	224.46	4.14	457.19
Source: Hanscom EXP System, HMMH					
Notes: 1. INM = Integrated Noise Model 2. SEPMIX = 75% GASEPF, 25% GASEPV					

Aircraft Type/Group		INM ¹ TYPE	Departures		Arrivals		Total
			Day	Night	Day	Night	
Civil:							
1	Cessna 550, 500	CNA500	0.87	0.05	0.85	0.08	1.85
2	Beechjet 400	MU3001	2.72	0.15	2.64	0.24	5.75
3	Lear 31, 35, 40, 45 ,55 ,60, Hawker Siddely 125-700, -800, - 1000, Sabreliner 65, Falcon 10, Beechcraft Premier 1	LEAR35	7.47	0.42	7.24	0.65	15.78
8	Gulfstream IV, 450	GIV	5.32	0.30	5.16	0.46	11.25
9	Challenger 600, Falcon 2000, IAI Galaxy, Embraer 135, Dornier 328J	CL600	3.24	0.18	3.14	0.28	6.85
10	Challenger 601, 604, 300, Falcon 200, Canadair RJ	CL601	6.29	0.36	6.10	0.55	13.29
17	Helicopters	SA365N	10.03	0.20	10.00	0.23	20.45
19	Dash-6, Beech 350, 1900, Embraer 120	DHC6	3.10	0.07	3.08	0.09	6.34
20	Twin Engine Piston Prop	BEC58P	5.17	0.12	5.16	0.12	10.58
21	Single Engine Piston Prop	SEPMIX ²	160.56	0.35	160.28	0.63	321.82
22	Westwind/ Astra 1124, 1125	IA1125	0.59	0.03	0.57	0.05	1.25
26	Falcon 50/900	F10062	2.40	0.14	2.32	0.21	5.06
29	Cessna 441, Beech King Air 90, 100, 200	CNA441	0.97	0.04	0.96	0.05	2.02
33	Piaggio 180, Shorts 330	SD330	0.96	0.04	0.95	0.05	2.01
37	Gulfstream V, 550, Global Express	GV	2.73	0.15	2.65	0.24	5.77
40	Cessna 750	CNA750	2.84	0.16	2.75	0.25	5.99
41	Boeing 737-800, 737-400	737800	0.47	0.03	0.46	0.04	1.00
43	Eclipse 500	ECLIPSE500	2.06	0.12	1.99	0.18	4.35
44	Cessna 525	CNA525C	1.70	0.10	1.65	0.15	3.60
45	Cessna 560	CNA560U	1.47	0.08	1.43	0.13	3.12
46	Cessna 560XL	CNA560XL	3.87	0.22	3.75	0.34	8.18
47	Lear 60, Cessna 510, Embraer Phenom	CNA55B	1.44	0.08	1.40	0.13	3.05
48	Cessna 680	CNA680	1.77	0.10	1.72	0.15	3.75
Subtotal Civil Operations			228.07	3.48	226.24	5.31	463.10
Military:							
3	Falcon 200	CL601	0.24	0.00	0.24	0.00	0.48
15	Boeing 707	707QN	0.09	0.00	0.09	0.00	0.18
20	Twin Engine Piston Prop	BEC58P	0.04	0.00	0.04	0.00	0.07
21	Single Engine Piston Prop	SEPMIX	0.65	0.00	0.65	0.01	1.31
Subtotal Military Operations			1.02	0.00	1.01	0.01	2.04
Total Operations:			229.09	3.48	227.26	5.32	465.15
Sources: SH&E, HMMH							
Notes: 1. INM = Integrated Noise Model 2. SEPMIX = 75% GASEPF, 25% GASEPV							

Table D-3 2030 Forecast Average Daily Operations

Aircraft Type/Group		INM ¹ TYPE	Departures		Arrivals		Total
			Day	Night	Day	Night	
Civil:							
1	Cessna 550, 500	CNA500	1.17	0.07	1.13	0.10	2.47
2	Beechjet 400	MU3001	3.63	0.21	3.52	0.32	7.68
3	Lear 31, 35, 40, 45 ,55 ,60, Hawker Siddely 125-700, -800, - 1000, Sabreliner 65, Falcon 10, Beechcraft Premier 1	LEAR35	9.97	0.56	9.66	0.87	21.07
8	Gulfstream IV, 450	GIV	7.11	0.40	6.89	0.62	15.01
9	Challenger 600, Falcon 2000, IAI Galaxy, Embraer 135, Dornier 328J	CL600	4.33	0.24	4.20	0.38	9.15
10	Challenger 601, 604, 300, Falcon 200, Canadair RJ	CL601	8.40	0.48	8.14	0.73	17.75
17	Helicopters	SA365N	10.03	0.20	10.00	0.23	20.45
19	Dash-6, Beech 350, 1900, Embraer 120	DHC6	4.37	0.79	4.35	0.10	9.60
20	Twin Engine Piston Prop	BEC58P	5.82	0.13	5.82	0.14	11.91
21	Single Engine Piston Prop	SEPMIX ²	176.29	0.44	175.95	0.78	353.46
22	Westwind/ Astra 1124, 1125	IA1125	0.79	0.04	0.76	0.07	1.67
26	Falcon 50/900	F10062	3.20	0.18	3.10	0.28	6.76
29	Cessna 441, Beech King Air 90, 100, 200	CNA441	1.03	0.04	1.02	0.06	2.15
33	Piaggio 180, Shorts 330	SD330	1.08	0.04	1.07	0.06	2.25
37	Gulfstream V, 550, Global Express	GV	3.65	0.21	3.54	0.32	7.71
40	Cessna 750	CNA750	3.79	0.21	3.67	0.33	8.00
41	Boeing 737-800, 737-400	737800	0.63	0.04	0.61	0.06	1.33
43	Eclipse 500	ECLIPSE500	2.75	0.16	2.66	0.24	5.80
44	Cessna 525	CNA525C	2.27	0.13	2.20	0.20	4.80
45	Cessna 560	CNA560U	1.97	0.11	1.91	0.17	4.16
46	Cessna 560XL	CNA560XL	5.17	0.29	5.01	0.45	10.92
47	Lear 60, Cessna 510, Embraer Phenom	CNA55B	1.92	0.11	1.87	0.17	4.07
48	Cessna 680	CNA680	2.37	0.13	2.29	0.21	5.00
Subtotal Civil Operations			261.74	5.21	259.36	6.87	533.18
Military:							
3	Falcon 200	CL601	0.24	0.00	0.24	0.00	0.48
15	Boeing 707	707QN	0.09	0.00	0.09	0.00	0.18
20	Twin Engine Piston Prop	BEC58P	0.04	0.00	0.04	0.00	0.07
21	Single Engine Piston Prop	SEPMIX	0.65	0.00	0.65	0.01	1.31
Subtotal Military Operations			1.02	0.00	1.01	0.01	2.04
Total Operations:			262.76	5.21	260.38	6.88	535.22
Sources: SH&E, HMMH							
Notes: 1. INM = Integrated Noise Model 2. SEPMIX = 75% GASEPF, 25% GASEPV							

D.4 Analysis of Land Use and Population within DNL Contours

In order to estimate the number of people residing within the noise contours, existing land use maps developed by parcel boundary were obtained from MassGIS and overlaid on 2010 US Census TIGER file maps that depict the smallest enumeration unit; Census block data. Polygons were then created using land use that concentrated populated areas into the residential portion of the census block where people actually live – for example, in some areas, the population is concentrated along the road, rather than over several square miles of open or undeveloped land .

Using Geographic Information Systems (GIS) tools, the noise contours were intersected with these “Residential/Census” data for each DNL noise contour interval. The resultant wholly or partially encompassed Residential/Census areas were then identified; the proportion of total area within the contour level was then computed to determine the estimated residential population and housing unit counts and ascribed to that level.

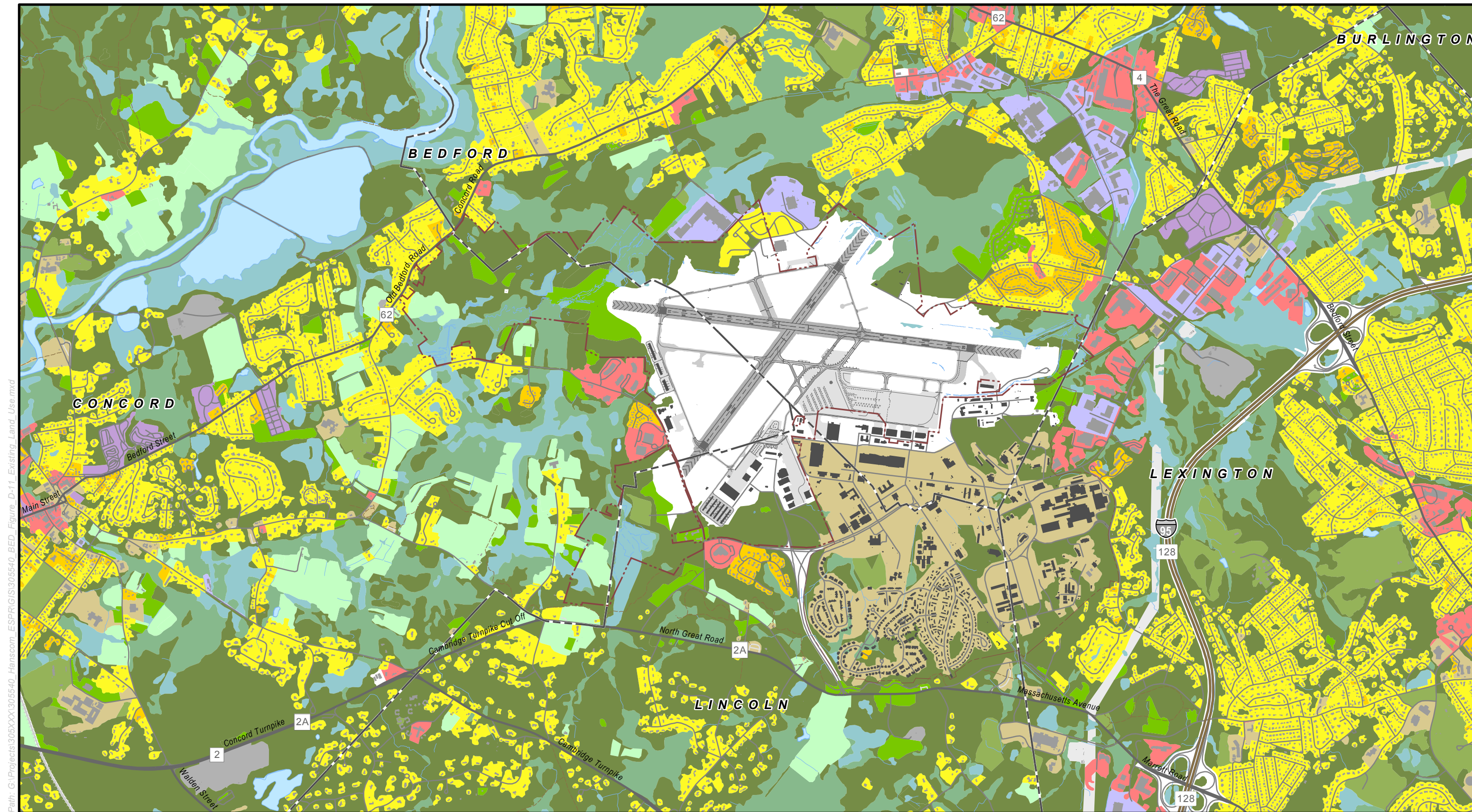
Figures D-11 and D-12 show the land use and census data and the process used for the analysis.

D.5 Time Above at Noise-Sensitive Receptors

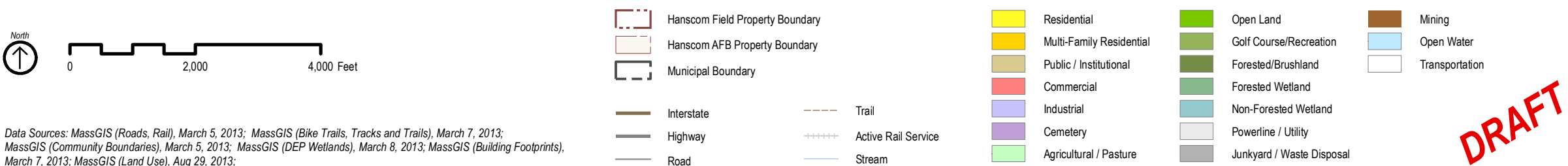
Table D-4 through Table D-7 and Table D-8 through Table D-11 present the calculated time above 65 dB and 55 dB values, respectively, for the noise sensitive receptors in 2012 and the 2020 and 2030 scenarios.

D.6 Total Noise Exposure (EXP)

Table D-12 presents detailed total EXP results for 2012 operations and the 2020 and 2030 scenarios, using SELs computed with INM version 7.0c.



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Data Sources: MassGIS (Roads, Rail), March 5, 2013; MassGIS (Bike Trails, Tracks and Trails), March 7, 2013; MassGIS (Community Boundaries), March 5, 2013; MassGIS (DEP Wetlands), March 8, 2013; MassGIS (Building Footprints), March 7, 2013; MassGIS (Land Use), Aug 29, 2013;

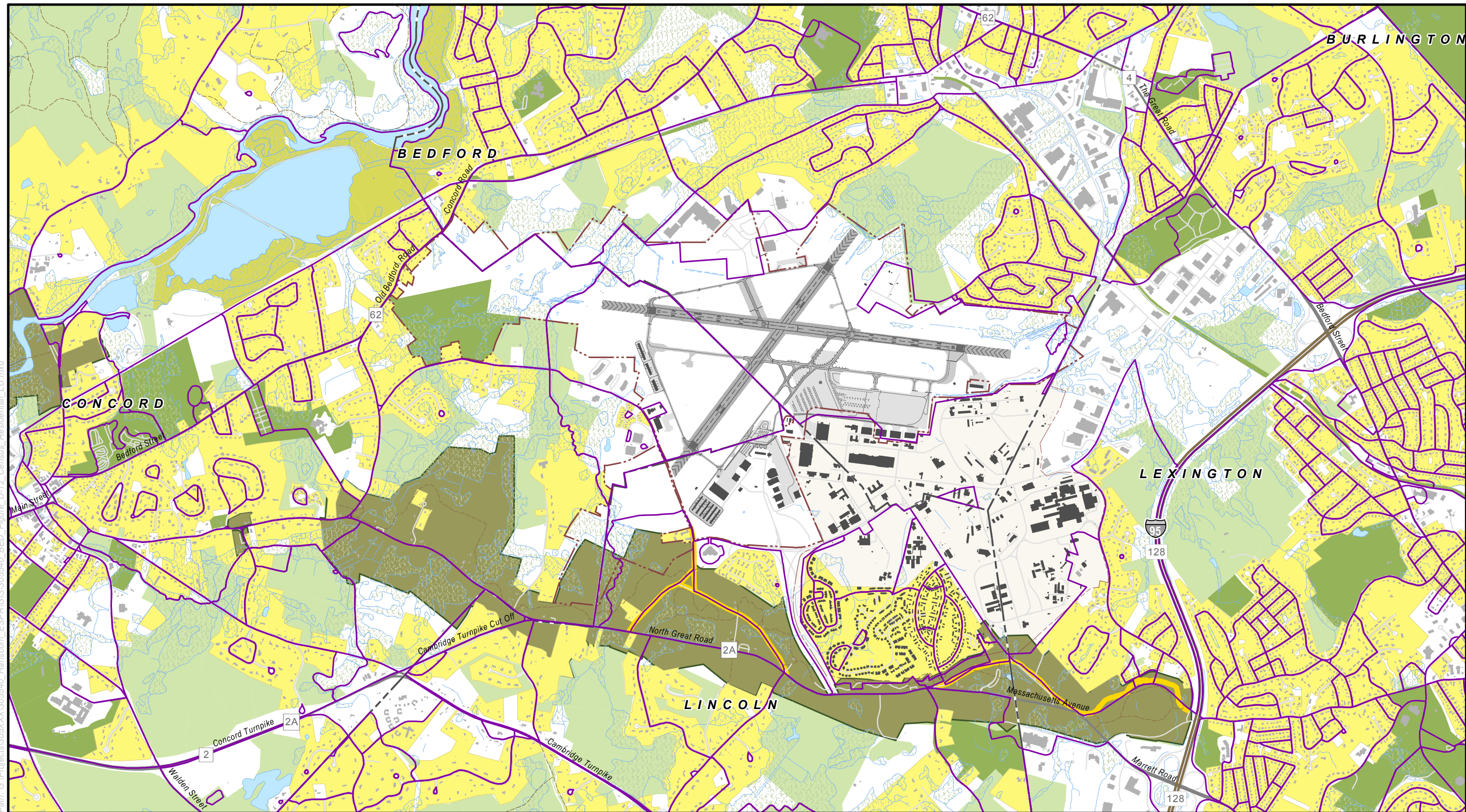
Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts

Existing Land Use

DRAFT

Figure D-11

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- | | | | |
|---------------------------------------|---------------------|------------------------------------|--------|
| 2010 US Census Block Boundary | Historic Road | Open Water | Stream |
| Populated Census/Residential Land Use | Interstate | Wetland/Marsh | |
| | Highway | | |
| | Road | MNP Boundary | |
| Hanscom Field Property Boundary | Trail | Great Meadows | |
| Hanscom AFB Property Boundary | Active Rail Service | Open Space Non-protected | |
| Municipal Boundary | | Open Space Protected in Perpetuity | |

Data Sources: MassGIS (Roads, Rail), March 5, 2013; MassGIS (Bike Trails, Tracks and Trails), March 7, 2013; MassGIS (Community Boundaries), March 5, 2013; MassGIS (DEP Wetlands), March 8, 2013; MassGIS (Building Footprints), March 7, 2013; US Census Bureau (Census Block Data), May 21, 2013; MassGIS (Parcel Boundaries), Sep 11, 2013;

DRAFT



Hanscom Field 2012 ESPR
Bedford, Concord, Lexington, Lincoln, Massachusetts
2010 Census Blocks and Residential Land Use

Figure D-12

Table D-4 Time Above 65 dB at Noise Sensitive Receptors in Bedford (minutes)

Label ¹	2005 Label ²	Name ³	Address	2012	2020	2030
HB-1	HB-1	Veterans Administration Medical Center*	200 Springs Rd.	0.5	0.6	0.8
NB-1	NB-1	Bedford Historic District	Great Rd.	1.0	1.1	1.4
NB-2	NB-2	Old Bedford Center Historic District	Great Rd.	1.4	1.6	1.9
NB-3	NB-3	Old Burying Ground	7 Springs Rd.	1.6	1.8	2.2
NB-4	NB-4	Old Town Hall	16 South Rd.	1.8	2.0	2.4
NB-5	NB-5	Bedford Depot Park Historic District	80 Loomis St./120 South Rd.	4.7	5.1	6.0
NB-6	NB-6	Nathaniel Page House	89 Page Rd.	2.3	2.7	3.3
NB-7	NB-7	Christopher Page House	50 Old Billerica Rd.	1.6	1.8	2.3
NB-8	NB-8	Bacon-Gleason-Blodgett Homestead	118 Wilson Rd.	0.7	0.8	1.0
NB-9	NB-9	Historic Wilson Mill-Old Burlington Road Historic Dist.	Old Burlington and Wilson Rds.	0.6	0.8	1.0
NB-10	OB-2	Shawsheen Cemetery **	Shawsheen Rd.	1.2	1.3	1.6
NB-11	-	David Lane House	137 North Rd.	0.5	0.6	0.7
OB-1	OB-1	Old Billerica Road Area ** (NR nomination form in process)	Old Billerica Rd.	1.7	2.0	2.5
PB-1	PB-1	Town Hall *	10 Mudge Way	1.4	1.6	1.9
PB-2	PB-2	Library **	7 Mudge Way	1.1	1.2	1.5
PB-3	PB-3	Bedford School District	11 Mudge Way	1.4	1.6	1.9
PB-4	PB-4	Department of Public Works	314 Great Rd.	1.5	1.6	2.0
RB-1	RB-1	The Lutheran Church of the Savior	426 Davis Rd.	3.6	4.3	5.4
RB-2	RB-2	First Baptist Church of Bedford	155 Concord Rd.	0.9	0.9	1.0
RB-3	RB-3	St. Michael's Church	90 Concord Rd.	0.9	0.9	1.0
RB-4	RB-4	Boston Buddha Vararam Temple	125 North Rd.	0.5	0.6	0.8
RB-5	RB-5	The First Church of Christ Congregational/ United Church of Christ *	25 Great Rd.	1.2	1.4	1.7
RB-6	RB-6	The First Parish in Bedford Unitarian Universalist *	75 Great Rd.	1.7	1.9	2.3
RB-7	RB-7	St. Paul's Episcopal Church	100 Pine Hill Rd.	0.5	0.6	0.7
RB-8	RB-8	March for Jesus	54 Summer St.	14.2	14.7	17.1
RB-9	RB-9	Immanuel Baptist Church/ Zion Korean Alliance Church ⁴	400 Great Rd.	1.4	1.6	1.9
SB-1	SB-1	Davis School	Davis Rd.	0.5	0.5	0.6
SB-2	SB-2	Bedford High School **	9 Mudge Way	1.1	1.2	1.5
SB-3	SB-3	John Glenn Middle School	99 McMahon Rd.	1.5	1.6	1.9

Source: HMMH

Notes:

1. The first letter of the label indicates the nature of each site: H for hospital, N for sites in the National Register of Historic Places and/or State Register of Historic Places, O for other, P for public facilities, R for religious sites, S for schools. Other is the category for sites that town representatives specifically requested be added to the noise receptor list, but do not fit into the other four categories. The second letter indicates the town where the site is located: B for Bedford, C for Concord, LX for Lexington, LN for Lincoln.
2. The labels have been updated for the 2012ESPR. The 2005ESPR labels are provided for reference purposes. Blanks indicate new locations that have been added to the 2012ESPR list of noise sensitive receptors.
3. Historic districts and cemeteries are evaluated at a central location within the district or cemetery. Sites that are not designated as "N" sites are marked with an asterisk (*) if they are listed in the National Register of Historic Places and two asterisks (**) if they are listed in the State Inventory/MACRIS. Sites are marked with a (†) if they are only listed in the State Register of Historic Places. Sites marked with a (††) contribute to the Old Bedford Center Historic District.
4. The Immanuel Baptist Church and Zion Korean Alliance Church are at the same address.
5. The boundary of the Old Bedford Center Historic District has slightly expanded, the Old Bedford Center Historic District Boundary Extension, since the last study in 2005.

Table D-5 Time Above 65 dB at Noise Sensitive Receptors in Concord (minutes)

Label ¹	2005 Label ²	Name ³	Address	2012	2020	2030
NC-1	NC-1	Barrett Farm Historic District†	Barrett's Mill Rd.	0.7	0.9	1.2
NC-2	NC-2	Jonathan Hildreth House	8 Barrett's Mill Rd.	2.7	3.4	4.4
NC-3	NC-3	Joseph Hosmer House	572 Main St.	0.9	1.1	1.4
NC-4	NC-4	Thoreau-Alcott House	255 Main St.	2.1	2.8	3.6
NC-5	NC-5	Hubbardville Historic District†	324-374 Sudbury Rd.	2.9	3.7	4.8
NC-6	NC-6	Hubbard-French Historic District	324-374 Sudbury Rd.	2.9	3.7	4.8
NC-7	NC-7	Deacon Thomas Hubbard/ Judge Henry French House	342 Sudbury Rd.	2.8	3.6	4.6
NC-8	NC-8	Pest House	158 Fairhaven Rd.	2.7	3.4	4.4
NC-9	NC-9	Main Street Historic District†	Main St. between Monument Sq. and Wood St.	3.7	4.6	6.0
NC-10	NC-10	North Bridge-Monument Square Historic District†	Monument St., Liberty St. and Lowell St.	3.3	4.1	5.3
NC-11	NC-11	Wright Tavern	Lexington Rd. & Main St.	3.8	4.8	6.3
NC-12	NC-12	Sleepy Hollow Cemetery	24 Court Ln.	4.3	5.5	7.2
NC-13	NC-13	American Mile Historic District†	Lexington Rd.	4.1	5.3	6.9
NC-14	NC-14	Concord Monument Square-Lexington Road Historic District	Monument Sq. and Lexington Rd.	3.7	4.6	6.1
NC-15	NC-15	Ralph Waldo Emerson House	28 Cambridge Turnpike	4.7	6.0	8.0
NC-16	NC-16	Walden Pond ⁴	MA Rte 126 (Main Beach)	1.0	1.2	1.4
NC-17	NC-17	Orchard House	399 Lexington Rd.	5.6	7.0	9.2
NC-18	NC-18	Deacon John Wheeler/ Capt. Jonas Minot Farmhouse	341 Virginia Rd.	36.0	39.0	46.8
NC-19	NC-19	Wheeler-Merriam House	477 Virginia Rd.	36.1	39.3	47.1
NC-20	-	Concord Armory-Concord Veteran's Building	51 Walden St.	3.8	4.8	6.3
NC-21	-	Concord School of Philosophy	391 Lexington Rd.	5.7	7.2	9.4
NC-22	-	Hosmer Homestead	138 Baker Ave.	0.3	0.3	0.4
PC-1	PC-1	Library **	129 Main St.	3.0	3.8	4.9
PC-2	PC-2	Town Hall ††	22 Monument Sq.	3.6	4.5	5.9
PC-3	PC-3	Middlesex County Court House	305 Walden St.	4.3	5.4	7.0
RC-1	RC-1	Trinity Episcopal Church **	81 Elm St.	1.3	1.6	2.0
RC-2	RC-2	Redeemer Presbyterian Church	191 Sudbury Rd.	2.9	3.7	4.8
RC-3	RC-3	New Life Community Church (meeting at the Emerson School Building **)	40 Stow St.	3.4	4.3	5.6
RC-4	RC-4	Trinitarian Congregational Church **	54 Walden St.	3.8	4.8	6.2
RC-5	RC-5	First Church of Christ Scientist††	7 Lowell Rd.	3.3	4.1	5.4
RC-6	RC-6	St. Bernard's Parish††	70 Monument Square	3.5	4.4	5.7
RC-7	RC-7	Christian Science Reading Room	20 Main St.	3.6	4.5	5.9
RC-8	RC-8	First Parish in Concord ††	20 Lexington Rd.	3.9	4.9	6.4
SC-1	SC-1	Nashoba/Brooks School	200 Strawberry Hill Rd.	2.8	3.5	4.5
SC-2	SC-2	Middlesex School**	1400 Lowell Rd.	0.3	0.4	0.5
SC-3	SC-3	Fenn School **	498-516 Monument St.	6.1	7.7	9.9
SC-4	SC-4	Concord Academy **	166 Main St.	2.4	3.2	4.1
SC-5	SC-5	Alcott School	91 Laurel Rd.	4.1	5.2	6.8
SC-6	SC-6	Concord/Carlisle High School	500 Walden Rd.	3.0	3.7	4.8
SC-7	SC-7	Ripley School	120 Meriam Rd.	9.8	12.3	16.0

Source: HMMH

Notes:

1. The first letter of the label indicates the nature of each site: H for hospital, N for sites in the National Register of Historic Places and/or State Register of Historic Places, O for other, P for public facilities, R for religious sites, S for schools. Other is the category for sites that town representatives specifically requested be added to the noise receptor list, but do not fit into the other four categories. The second letter indicates the town where the site is located: B for Bedford, C for Concord, LX for Lexington, LN for Lincoln.
2. The labels have been updated for the 2012ESPR. The 2005ESPR labels are provided for reference purposes. Blanks indicate new locations that have been added to the 2012ESPR list of noise sensitive receptors. The Old Manse and the Wayside (Samuel Whitney House) are included in the Minute Man National Historical Park list of noise sensitive receptors.
3. Historic districts and cemeteries are evaluated at a central location within the district or cemetery. Sites that are not designated as “N” sites are marked with an asterisk (*) if they are listed in the National Register of Historic Places and two asterisks (**) if they are listed in the State Inventory/MACRIS. Sites are marked with a (†) if they are only listed in the State Register of Historic Places. Sites marked with a (††) contribute to the Concord Monument Square-Lexington Road Historic District.
4. The Walden Pond State Reservation is located in Concord and Lincoln. This site is located at the main beach in Concord.

Table D-6 Time Above 65 dB at Noise Sensitive Receptors in Lexington (minutes)

Label ¹	2005 Label ²	Name ³	Address	2012	2020	2030
NLX-1	NLX-1	Simonds Tavern	331 Bedford St.	10.2	12.2	15.3
NLX-2	NLX-2	Hancock-Clarke Historic District†	Hancock St.	0.9	1.0	1.2
NLX-3	NLX-3	Hancock-Clarke House	35 Hancock St.	0.8	0.9	1.1
NLX-4	NLX-4	Garrity House	9 Hancock St.	0.9	1.0	1.3
NLX-5	NLX-5	Lexington Green Historic District	Mass. Ave., Harrington Rd. and Bedford St.	0.9	1.1	1.4
NLX-6	NLX-6	Lexington Green	Mass. Ave., Harrington Rd. and Bedford St.	0.9	1.0	1.3
NLX-7	NLX-7	Buckman Tavern	1 Bedford St.	0.9	1.0	1.2
NLX-8	NLX-8	General Samuel Chandler House	8 Goodwin Rd.	0.8	0.9	1.2
NLX-9	NLX-9	Hancock School	33 Forest St.	0.9	1.1	1.3
NLX-10	NLX-10	U.S. Post Office Building	1661 Mass. Ave.	0.5	0.6	0.8
NLX-11	NLX-11	Warren E. Shelburne House	11 Percy Rd.	0.3	0.3	0.4
NLX-12	NLX-12	Munroe Tavern Historic District†	Mass. Ave.	0.2	0.2	0.2
NLX-13	NLX-13	Sanderson House-Munroe Tavern	1314 & 1332 Mass. Ave.	0.2	0.2	0.3
NLX-14	NLX-14	John Mason House	1303 Mass. Ave.	0.2	0.2	0.3
NLX-15	NLX-15	East Village Historical District†	Mass Ave.	0.1	0.1	0.1
NLX-16	-	M.H. Merriam and Company	7-9 Oakland Ave.	0.7	0.8	1.0
OLX-1	OLX-1	Battle Green Historic District**	Worthen Rd., Woburn St., Hastings Rd., Mass. Ave. and B&M Railroad	0.9	1.0	1.3
OLX-2	OLX-2	National Heritage Museum	33 Marrett Rd.	0.1	0.2	0.2
PLX-1	PLX-1	Library **	1874 Mass. Ave.	1.0	1.1	1.4
PLX-2	PLX-2	Town Hall **	1625 Mass. Ave.	0.3	0.4	0.5
PLX-3	PLX-3	Lexington School District Administration **	1557 Massachusetts Ave.	0.4	0.5	0.6
RLX-1	RLX-1	Lexington United Methodist Church/ St. John's Korean United Methodist Church ⁴	2600 Massachusetts Ave.	2.0	2.4	3.2
RLX-2	RLX-2	Temple Isaiah	55 Lincoln St.	1.5	1.8	2.3
RLX-3	RLX-3	Grace Chapel of Lexington	59 Worthen Rd.	1.5	1.8	2.2
RLX-4	RLX-4	St. Brigid's Parish *	2001 Mass. Ave.	1.3	1.5	1.9
RLX-5	RLX-5	First Parish-Unitarian Church††	7 Harrington Rd.	1.0	1.2	1.5
RLX-6	RLX-6	Hancock United Church of Christ ††	1912 Mass. Ave.	1.0	1.1	1.4
RLX-7	RLX-7	Church of Our Redeemer	6 Meriam St.	0.8	0.9	1.2
RLX-8	RLX-8	Christian Science Reading Room	10 Muzzy St. #12	0.7	0.9	1.1
RLX-9	RLX-9	Greek Orthodox Church of St. Nichols **	17 Meriam St.	0.7	0.8	1.0
RLX-10	RLX-10	Chabad Center **	9 Burlington St.	5.9	6.9	8.7
RLX-11	RLX-11	Pilgrim Congregational Church	55 Coolidge Ave.	1.1	1.3	1.6
RLX-12	RLX-12	First Baptist Church of Lexington **	1580 Mass. Ave.	0.4	0.5	0.6
RLX-13	RLX-13	Jehovah's Witnesses	196 Woburn St.	0.1	0.1	0.2
RLX-14	RLX-14	Follen Church Society-Unitarian Universalists *	755 Massachusetts Ave.	0.1	0.1	0.1
RLX-15	RLX-15	Countryside Bible Chapel	480 Lowell St.	0.1	0.1	0.1
RLX-16	RLX-16	St. Paul Evangelical Church	451 Lowell St.	0.1	0.1	0.1
SLX-1	SLX-1	Minuteman Regional Vocational High School	758 Marrett Rd.	1.0	1.2	1.4

SLX-2	SLX-2	Maria Hastings School	2618 Mass. Ave.	1.7	2.1	2.8
SLX-3	SLX-3	Methodist Weekday School	2600 Massachusetts Ave.	2.0	2.5	3.2
SLX-4	SLX-4	Community Nursery School	2325 Massachusetts Ave.	2.1	2.5	3.3
SLX-5	SLX-5	Bridge Elementary School**	55 Middleby Rd.	1.0	1.3	1.6
SLX-6	SLX-6	Lexington High School	251 Waltham St.	0.8	0.9	1.2
SLX-7	SLX-7	Jonas Clarke Middle School	17 Stedman Rd.	0.2	0.3	0.3
SLX-8	SLX-8	Estabrook School**	117 Grove St.	1.4	1.7	2.2
SLX-9	SLX-9	Diamond Middle School	99 Hancock St.	5.4	6.4	8.1
SLX-10	SLX-10	Fiske Elementary School	146 Maple St.	0.6	0.6	0.8
SLX-11	SLX-11	Armenian Sisters Academy	20 Pelham Rd.	0.2	0.2	0.3
SLX-12	SLX-12	Harrington Elementary School	148 Maple St.	0.0	0.0	0.1

Source: HMMH

Notes:

1. The first letter of the label indicates the nature of each site: H for hospital, N for sites in the National Register of Historic Places and/or State Register of Historic Places, O for other, P for public facilities, R for religious sites, S for schools. Other is the category for sites that town representatives specifically requested be added to the noise receptor list, but do not fit into the other four categories, or historic districts that are not on the National Register of Historic Places. The second letter indicates the town where the site is located: B for Bedford, C for Concord, LX for Lexington, LN for Lincoln.

2. The labels have been updated for the 2012ESPR. The 2005ESPR labels are provided for reference purposes. Blanks indicate new locations that have been added to the 2012ESPR list of noise sensitive receptors.

3. Historic districts and cemeteries are evaluated at a central location within the district or cemetery. Sites that are not designated as "N" sites are marked with an asterisk (*) if they are listed in the National Register of Historic Places and two asterisks (**) if they are listed in the State Inventory/MACRIS. Sites are marked with a (†) if they are only listed in the State Register of Historic Places. Sites marked with a (††) contribute to the Lexington Green Historic District.

4. The Lexington United Methodist Church and St. John's Korean United Methodist Church are at the same address.

Table D-8 Time Above 55 dB at Noise Sensitive Receptors in Bedford (minutes)

Label ¹	2005 Label ²	Name ³	Address	2012	2020	2030
HB-1	HB-1	Veterans Administration Medical Center*	200 Springs Rd.	7.3	8.2	10.1
NB-1	NB-1	Bedford Historic District	Great Rd.	17.0	17.0	19.4
NB-2	NB-2	Old Bedford Center Historic District	Great Rd.	20.8	20.7	23.6
NB-3	NB-3	Old Burying Ground	7 Springs Rd.	18.9	19.1	21.9
NB-4	NB-4	Old Town Hall	16 South Rd.	22.2	22.1	25.3
NB-5	NB-5	Bedford Depot Park Historic District	80 Loomis St./120 South Rd.	46.4	45.8	51.8
NB-6	NB-6	Nathaniel Page House	89 Page Rd.	15.3	16.3	19.3
NB-7	NB-7	Christopher Page House	50 Old Billerica Rd.	12.5	13.7	16.3
NB-8	NB-8	Bacon-Gleason-Blodgett Homestead	118 Wilson Rd.	8.4	9.4	11.6
NB-9	NB-9	Historic Wilson Mill-Old Burlington Road Historic Dist.	Old Burlington and Wilson Rds.	8.3	9.3	11.5
NB-10	OB-2	Shawsheen Cemetery **	Shawsheen Rd.	27.0	27.5	32.0
NB-11	-	David Lane House	137 North Rd.	7.0	7.6	9.4
OB-1	OB-1	Old Billerica Road Area ** (NR nomination form in process)	Old Billerica Rd	11.9	13.0	15.9
PB-1	PB-1	Town Hall *	10 Mudge Way	24.8	24.3	27.3
PB-2	PB-2	Library **	7 Mudge Way	24.0	23.3	26.2
PB-3	PB-3	Bedford School District	11 Mudge Way	26.6	25.9	29.1
PB-4	PB-4	Department of Public Works	314 Great Rd.	27.6	28.0	32.5
RB-1	RB-1	The Lutheran Church of the Savior	426 Davis Rd.	43.1	47.1	57.1
RB-2	RB-2	First Baptist Church of Bedford	155 Concord Rd.	35.1	35.0	40.1
RB-3	RB-3	St. Michael's Church	90 Concord Rd.	25.6	24.8	27.7
RB-4	RB-4	Boston Buddha Vararam Temple	125 North Rd.	7.1	7.9	9.5
RB-5	RB-5	The First Church of Christ Congregational/ United Church of Christ *	25 Great Rd.	21.5	21.2	24.1
RB-6	RB-6	The First Parish in Bedford Unitarian Universalist *	75 Great Rd.	23.4	23.2	26.3
RB-7	RB-7	St. Paul's Episcopal Church	100 Pine Hill Rd.	6.8	7.5	9.2
RB-8	RB-8	March for Jesus	54 Summer St.	84.2	87.9	103.0
RB-9	RB-9	Immanuel Baptist Church/ Zion Korean Alliance Church ⁴	400 Great Rd.	31.0	31.6	36.7
SB-1	SB-1	Davis School	Davis Rd.	14.6	14.5	16.5
SB-2	SB-2	Bedford High School **	9 Mudge Way	26.3	25.5	28.3
SB-3	SB-3	John Glenn Middle School	99 McMahon Rd.	38.5	37.0	41.1

Source: HMMH

Notes:

1. The first letter of the label indicates the nature of each site: H for hospital, N for sites in the National Register of Historic Places and/or State Register of Historic Places, O for other, P for public facilities, R for religious sites, S for schools. Other is the category for sites that town representatives specifically requested be added to the noise receptor list, but do not fit into the other four categories. The second letter indicates the town where the site is located: B for Bedford, C for Concord, LX for Lexington, LN for Lincoln.

2. The labels have been updated for the 2012ESPR. The 2005ESPR labels are provided for reference purposes. Blanks indicate new locations that have been added to the 2012ESPR list of noise sensitive receptors.

3. Historic districts and cemeteries are evaluated at a central location within the district or cemetery. Sites that are not designated as "N" sites are marked with an asterisk (*) if they are listed in the National Register of Historic Places and two asterisks (**) if they are listed in the State Inventory/MACRIS. Sites are marked with a (†) if they are only listed in the State Register of Historic Places. Sites marked with a (††) contribute to the Old Bedford Center Historic District.

4. The Immanuel Baptist Church and Zion Korean Alliance Church are at the same address.

5. The boundary of the Old Bedford Center Historic District has slightly expanded, the Old Bedford Center Historic District Boundary Extension, since the last study in 2005.

Table D-9 Time Above 55 dB at Noise Sensitive Receptors in Concord (minutes)

Label ¹	2005 Label ²	Name ³	Address	2012	2020	2030
NC-1	NC-1	Barrett Farm Historic District†	Barrett's Mill Rd.	11.9	14.1	17.5
NC-2	NC-2	Jonathan Hildreth House	8 Barrett's Mill Rd.	20.9	24.9	31.4
NC-3	NC-3	Joseph Hosmer House	572 Main St.	14.2	16.6	20.9
NC-4	NC-4	Thoreau-Alcott House	255 Main St.	19.6	23.1	29.3
NC-5	NC-5	Hubbardville Historic District†	324-374 Sudbury Rd.	19.0	22.4	28.3
NC-6	NC-6	Hubbard-French Historic District	324-374 Sudbury Rd.	19.0	22.4	28.3
NC-7	NC-7	Deacon Thomas Hubbard/ Judge Henry French House	342 Sudbury Rd.	18.9	22.3	28.3
NC-8	NC-8	Pest House	158 Fairhaven Rd.	18.7	22.0	27.8
NC-9	NC-9	Main Street Historic District†	Main St. between Monument Sq. and Wood St.	24.8	29.2	36.8
NC-10	NC-10	North Bridge-Monument Square Historic District†	Monument St., Liberty St. and Lowell St.	26.7	31.6	39.9
NC-11	NC-11	Wright Tavern	Lexington Rd. & Main St.	24.9	29.4	37.0
NC-12	NC-12	Sleepy Hollow Cemetery	24 Court Ln.	28.3	33.3	42.0
NC-13	NC-13	American Mile Historic District†	Lexington Rd.	25.7	30.3	38.1
NC-14	NC-14	Concord Monument Square-Lexington Road Historic District	Monument Sq. and Lexington Rd.	24.9	29.4	37.0
NC-15	NC-15	Ralph Waldo Emerson House	28 Cambridge Turnpike	26.7	31.4	39.6
NC-16	NC-16	Walden Pond ⁴	MA Rte 126 (Main Beach)	13.5	15.1	18.6
NC-17	NC-17	Orchard House	399 Lexington Rd.	32.4	37.5	46.9
NC-18	NC-18	Deacon John Wheeler/ Capt. Jonas Minot Farmhouse	341 Virginia Rd.	162.1	166.2	192.5
NC-19	NC-19	Wheeler-Merriam House	477 Virginia Rd.	170.0	174.0	201.5
NC-20	-	Concord Armory-Concord Veteran's Building	51 Walden St.	24.4	28.7	36.3
NC-21	-	Concord School of Philosophy	391 Lexington Rd.	32.7	37.9	47.3
NC-22	-	Hosmer Homestead	138 Baker Ave.	7.6	8.7	10.7
PC-1	PC-1	Library **	129 Main St.	21.9	25.9	32.7
PC-2	PC-2	Town Hall ††	22 Monument Sq.	25.2	29.7	37.4
PC-3	PC-3	Middlesex County Court House	305 Walden St.	24.1	28.2	35.6
RC-1	RC-1	Trinity Episcopal Church **	81 Elm St.	16.5	19.4	24.5
RC-2	RC-2	Redeemer Presbyterian Church	191 Sudbury Rd.	20.1	23.8	30.1
RC-3	RC-3	New Life Community Church (meeting at the Emerson School Building **)	40 Stow St.	22.2	26.3	33.1
RC-4	RC-4	Trinitarian Congregational Church **	54 Walden St.	23.9	28.1	35.6
RC-5	RC-5	First Church of Christ Scientist††	7 Lowell Rd.	24.3	28.6	36.2
RC-6	RC-6	St. Bernard's Parish††	70 Monument Square	24.6	29.0	36.6
RC-7	RC-7	Christian Science Reading Room	20 Main St.	24.4	28.7	36.3
RC-8	RC-8	First Parish in Concord ††	20 Lexington Rd.	24.9	29.4	37.0
SC-1	SC-1	Nashoba/Brooks School	200 Strawberry Hill Rd.	16.3	19.5	24.5
SC-2	SC-2	Middlesex School**	1400 Lowell Rd.	6.6	7.5	9.3
SC-3	SC-3	Fenn School **	498-516 Monument St.	32.5	38.3	48.1
SC-4	SC-4	Concord Academy **	166 Main St.	20.9	24.7	31.1
SC-5	SC-5	Alcott School	91 Laurel Rd.	22.9	27.0	34.2
SC-6	SC-6	Concord/Carlisle High School	500 Walden Rd.	20.2	23.8	30.0
SC-7	SC-7	Ripley School	120 Meriam Rd.	55.6	62.1	75.7

Source: HMMH

Notes:

1. The first letter of the label indicates the nature of each site: H for hospital, N for sites in the National Register of Historic Places and/or State Register of Historic Places, O for other, P for public facilities, R for religious sites, S for schools. Other is the category for sites that town representatives specifically requested be added to the noise receptor list, but do not fit into the other four categories. The second letter indicates the town where the site is located: B for Bedford, C for Concord, LX for Lexington, LN for Lincoln.
2. The labels have been updated for the 2012ESPR. The 2005ESPR labels are provided for reference purposes. Blanks indicate new locations that have been added to the 2012ESPR list of noise sensitive receptors. The Old Manse and the Wayside (Samuel Whitney House) are included in the Minute Man National Historical Park list of noise sensitive receptors.
3. Historic districts and cemeteries are evaluated at a central location within the district or cemetery. Sites that are not designated as "N" sites are marked with an asterisk (*) if they are listed in the National Register of Historic Places and two asterisks (**) if they are listed in the State Inventory/MACRIS. Sites are marked with a (†) if they are only listed in the State Register of Historic Places. Sites marked with a (††) contribute to the Concord Monument Square-Lexington Road Historic District.
4. The Walden Pond State Reservation is located in Concord and Lincoln. This site is located at the main beach in Concord.

Table D-10 Time Above 55 dB at Noise Sensitive Receptors in Lexington (minutes)

Label ¹	2005 Label ²	Name ³	Address	2012	2020	2030
NLX-1	NLX-1	Simonds Tavern	331 Bedford St.	43.9	48.6	58.8
NLX-2	NLX-2	Hancock-Clarke Historic District†	Hancock St.	9.4	9.7	11.6
NLX-3	NLX-3	Hancock-Clarke House	35 Hancock St.	9.1	9.4	11.2
NLX-4	NLX-4	Garrity House	9 Hancock St.	9.3	9.6	11.4
NLX-5	NLX-5	Lexington Green Historic District	Mass. Ave., Harrington Rd. and Bedford St.	9.6	9.9	11.8
NLX-6	NLX-6	Lexington Green	Mass. Ave., Harrington Rd. and Bedford St.	9.3	9.7	11.5
NLX-7	NLX-7	Buckman Tavern	1 Bedford St.	8.8	9.2	10.9
NLX-8	NLX-8	General Samuel Chandler House	8 Goodwin Rd.	8.9	9.3	11.0
NLX-9	NLX-9	Hancock School	33 Forest St.	8.9	9.3	11.2
NLX-10	NLX-10	U.S. Post Office Building	1661 Mass. Ave.	6.2	6.5	7.9
NLX-11	NLX-11	Warren E. Shelburne House	11 Percy Rd.	3.3	3.5	4.3
NLX-12	NLX-12	Munroe Tavern Historic District†	Mass. Ave.	2.0	2.2	2.8
NLX-13	NLX-13	Sanderson House-Munroe Tavern	1314 & 1332 Mass. Ave.	2.7	2.8	3.5
NLX-14	NLX-14	John Mason House	1303 Mass. Ave.	2.9	3.1	3.8
NLX-15	NLX-15	East Village Historical District†	Mass Ave.	1.3	1.5	1.8
NLX-16	-	M.H. Merriam and Company	7-9 Oakland Ave.	7.4	7.6	9.2
OLX-1	OLX-1	Battle Green Historic District**	Worthen Rd., Woburn St., Hastings Rd., Mass. Ave. and B&M Railroad	9.3	9.7	11.5
OLX-2	OLX-2	National Heritage Museum	33 Marrett Rd.	1.7	1.8	2.3
PLX-1	PLX-1	Library **	1874 Mass. Ave.	10.0	10.4	12.3
PLX-2	PLX-2	Town Hall **	1625 Mass. Ave.	4.3	4.5	5.5
PLX-3	PLX-3	Lexington School District Administration **	1557 Massachusetts Ave.	5.2	5.4	6.5
RLX-1	RLX-1	Lexington United Methodist Church/ St. John's Korean United Methodist Church ⁴	2600 Massachusetts Ave.	17.3	18.4	21.7
RLX-2	RLX-2	Temple Isaiah	55 Lincoln St.	11.6	12.4	15.1
RLX-3	RLX-3	Grace Chapel of Lexington	59 Worthen Rd.	13.7	14.1	16.6
RLX-4	RLX-4	St. Brigid's Parish *	2001 Mass. Ave.	12.0	12.4	14.7
RLX-5	RLX-5	First Parish-Unitarian Church††	7 Harrington Rd.	10.2	10.6	12.6
RLX-6	RLX-6	Hancock United Church of Christ ††	1912 Mass. Ave.	9.7	10.1	12.0
RLX-7	RLX-7	Church of Our Redeemer	6 Meriam St.	8.6	8.9	10.6
RLX-9	RLX-9	Greek Orthodox Church of St. Nichols **	17 Meriam St.	8.0	8.3	9.8
RLX-10	RLX-10	Chabad Center **	9 Burlington St.	30.8	33.8	40.8
RLX-11	RLX-11	Pilgrim Congregational Church	55 Coolidge Ave.	17.9	19.4	23.1
RLX-12	RLX-12	First Baptist Church of Lexington **	1580 Mass. Ave.	5.2	5.5	6.6
RLX-13	RLX-13	Jehovah's Witnesses	196 Woburn St.	2.2	2.3	2.8
RLX-14	RLX-14	Follen Church Society- Unitarian Universalists *	755 Massachusetts Ave.	0.9	1.0	1.2
RLX-15	RLX-15	Countryside Bible Chapel	480 Lowell St.	2.9	3.0	3.5
RLX-16	RLX-16	St. Paul Evangelical Church	451 Lowell St.	1.9	1.9	2.3
SLX-1	SLX-1	Minuteman Regional Vocational High School	758 Marrett Rd.	17.1	17.6	20.5
SLX-2	SLX-2	Maria Hastings School	2618 Mass. Ave.	14.7	15.8	19.0
SLX-3	SLX-3	Methodist Weekday School	2600 Massachusetts Ave.	17.7	18.7	22.1
SLX-4	SLX-4	Community Nursery School	2325 Massachusetts Ave.	16.2	17.0	20.2
SLX-5	SLX-5	Bridge Elementary School**	55 Middleby Rd.	6.7	7.9	10.1
SLX-6	SLX-6	Lexington High School	251 Waltham St.	6.9	7.6	9.5

SLX-7	SLX-7	Jonas Clarke Middle School	17 Stedman Rd.	2.8	3.2	4.1
SLX-8	SLX-8	Estabrook School**	117 Grove St.	10.3	11.8	14.8
SLX-9	SLX-9	Diamond Middle School	99 Hancock St.	26.8	29.7	36.0
SLX-10	SLX-10	Fiske Elementary School	146 Maple St.	10.5	11.2	13.5
SLX-11	SLX-11	Armenian Sisters Academy	20 Pelham Rd.	2.2	2.4	3.2
SLX-12	SLX-12	Harrington Elementary School	148 Maple St.	0.9	1.0	1.2

Source: HMMH

Notes:

1. The first letter of the label indicates the nature of each site: H for hospital, N for sites in the National Register of Historic Places and/or State Register of Historic Places, O for other, P for public facilities, R for religious sites, S for schools. Other is the category for sites that town representatives specifically requested be added to the noise receptor list, but do not fit into the other four categories, or historic districts that are not on the National Register of Historic Places. The second letter indicates the town where the site is located: B for Bedford, C for Concord, LX for Lexington, LN for Lincoln.

2. The labels have been updated for the 2012ESPR. The 2005ESPR labels are provided for reference purposes. Blanks indicate new locations that have been added to the 2012ESPR list of noise sensitive receptors.

3. Historic districts and cemeteries are evaluated at a central location within the district or cemetery. Sites that are not designated as "N" sites are marked with an asterisk (*) if they are listed in the National Register of Historic Places and two asterisks (**) if they are listed in the State Inventory/MACRIS. Sites are marked with a (†) if they are only listed in the State Register of Historic Places. Sites marked with a (††) contribute to the Lexington Green Historic District.

4. The Lexington United Methodist Church and St. John's Korean United Methodist Church are at the same address.

Table D-11 Time Above 55 dB at Noise Sensitive Receptors in Lincoln (minutes)

Label ¹	2005 Label ²	Name ³	Address	2012	2020	2030
NLN-1	NLN-1	Walden Pond ⁴	Rte. 126, Walden St., Concord Rd.	11.0	12.4	15.3
NLN-2	NLN-2	Henry Higginson House	44 Baker Farm Rd.	10.0	11.0	13.4
NLN-3	NLN-3	Daniel Brooks House	Brooks Rd.	28.7	28.9	32.8
NLN-4	NLN-4	Lincoln Center Historic District	Bedford Rd. Lincoln Rd., Old Lexington Rd. Sandy Pond Rd. Trapelo Rd. Weston Rd.	6.6	6.9	8.2
NLN-5	NLN-5	Hoar Tavern	268 Cambridge Tpke.	6.3	7.0	8.7
SLN-1	SLN-1	Carroll School	25 Baker Bridge Rd.	6.7	7.2	8.7
SLN-2	SLN-2	Hanscom Middle School	Hanscom AFB	93.6	91.1	101.7
SLN-3	SLN-3	Hanscom Primary School	Hanscom AFB	92.6	90.2	100.8

Source: HMMH

Notes:

1. The first letter of the label indicates the nature of each site: H for hospital, N for sites in the National Register of Historic Places and/or State Register of Historic Places, O for other, P for public facilities, R for religious sites, S for schools. Other is the category for sites that town representatives specifically requested be added to the noise receptor list, but do not fit into the other four categories. The second letter indicates the town where the site is located: B for Bedford, C for Concord, LX for Lexington, LN for Lincoln.
2. The labels have been updated for the 2012ESPR. The 2005ESPR labels are provided for reference purposes. Blanks indicate new locations that have been added to the 2012ESPR list of noise sensitive receptors.
3. Historic districts and cemeteries are evaluated at a central location within the district or cemetery. Sites that are not designated as "N" sites are marked with an asterisk (*) if they are listed in the National Register of Historic Places and two asterisks (**) if they are listed in the State Inventory/MACRIS.
4. The Walden Pond State Reservation is located in Concord and Lincoln. This site is in Heywood's Meadow.

Table D-12 Total EXP by Aircraft Group

Aircraft Type/Group		INM ¹ TYPE	Total Noise Exposure		
			2012	2020	2030
Civil:					
1	Cessna 550, 500	CNA500	88.87	89.16	90.42
2	Beechjet 400	MU3001	97.58	99.19	100.45
3	Lear 31, 35, 40, 45 ,55 ,60, Hawker Siddely 125-700, -800, - 1000, Sabreliner 65, Falcon 10, Beechcraft Premier 1	LEAR35	101.98	103.32	104.58
5	Lear 24, 25, Hawker Siddely 125-400, -600	LEAR25	96.13	0.00	0.00
7	Gulfstream III	GIIB	90.39	0.00	0.00
8	Gulfstream IV, 450	GIV	96.49	97.53	98.79
9	Challenger 600, Falcon 2000, IAI Galaxy, Embraer 135, Dornier 328J	CL600	94.96	96.54	97.80
10	Challenger 601, 604, 300, Falcon 200, Canadair RJ	CL601	97.71	98.99	100.24
11	Boeing 747, 767, Unknown/Miscellaneous Jets	74710Q	92.88	0.00	0.00
14	Douglas DC-9	DC93LW	91.52	0.00	0.00
17	Helicopters	SA365N	99.05	99.09	99.09
18	Gulfstream I	HS748A	70.76	0.00	0.00
19	Dash-6, Beech 350, 1900, Embraer 120	DHC6	96.67	98.14	100.00
20	Twin Engine Piston Prop	BEC58P	94.40	94.57	95.08
21	Single Engine Piston Prop	SEPMIX	104.98	104.68	105.10
22	Westwind/ Astra 1124, 1125	IA1125	90.80	91.46	92.71
25	Cessna 650	CIT3	83.54	0.00	0.00
26	Falcon 50/900	F10062	95.29	96.99	98.24
29	Cessna 441, Beech King Air 90, 100, 200	CNA441	84.65	84.67	84.95
30	Saab 340	SF340	69.51	0.00	0.00
32	Boeing 727	727EM2	88.42	0.00	0.00
33	Piaggio 180, Shorts 330	SD330	89.03	89.18	89.68
34	Boeing 737-200	737N17	87.12	0.00	0.00
35	Dornier 328, de Havilland DHC-8	DO328	78.56	0.00	0.00
36	Airbus 319, 320	A320-211	81.10	0.00	0.00
37	Gulfstream V, 550, Global Express	GV	95.30	96.31	97.57
39	Gulfstream II	GII	88.04	0.00	0.00
40	Cessna 750	CNA750	95.14	97.23	98.49
41	Boeing 737-800, 737-400	737800	95.72	94.14	95.39
42	Boeing 757	757RR	80.50	0.00	0.00
43	Eclipse 500	ECLIPSE500	83.79	84.75	86.00
44	Cessna 525	CNA525C	87.79	90.94	92.20
45	Cessna 560	CNA560U	91.35	93.99	95.25
46	Cessna 560XL	CNA560XL	95.67	97.87	99.13
47	Lear 60, Cessna 510, Embraer Phenom	CNA55B	91.15	93.24	94.50
48	Cessna 680	CNA680	90.32	92.35	93.60
Military:					
3	Falcon 200	CL601	78.08	82.68	82.68
15	Boeing 707	707QN	92.64	95.17	95.17
20	Twin Engine Piston Prop	BEC58P	66.89	72.27	72.27
21	Single Engine Piston Prop	SEPMIX	75.78	80.87	80.87
All civil aircraft except single piston			109.4	110.0	111.2
All civil aircraft			110.7	111.1	112.1

Noise

All military aircraft	92.9	95.6	95.6
All civil and military aircraft except single piston	109.5	110.1	111.3
All civil and military aircraft	110.8	111.2	112.2
Source: HMMH			
Notes: 1. INM = Integrated Noise Model 2. SEPMIX = 75% GASEPF, 25% GASEPV			

Appendix E Air Quality

305540 2012 INM Operation for Air Quality Analysis
2012 Operations
Average Annual Day
bln 9/30/13

Group	Sector	EDMS	Engine Type	Departures		Arrivals		Annual LTOs	Annual TGOs
				Day	Night	Day	Night		
1	CIV	Cessna 500 citation 1	JT15D-1	0.65	0.03	0.62	0.05	248	0
2	CIV	Beechjet 400	JT15D-5	1.93	0.11	1.94	0.10	746	0
3	CIV	Bombadier Learjet 35	TFE731-2-2B	5.37	0.32	5.20	0.49	2,084	0
3M	MIL	Falcon 200	CF700-2D	0.07	0.00	0.07	0.00	27	0
5	CIV	Bombadier Learjet 25	CJ610-6	0.05	0.01	0.05	0.01	19	0
7	CIV	Gulfstream -IIB	SPEY MK511	0.09	0.01	0.10	0.00	36	0
8	CIV	Gulfstream IV	TAY-MK611-8	3.62	0.28	3.47	0.43	1,427	0
9	CIV	Bombadier Challenger 600	ALF 502L-2	2.52	0.10	2.45	0.17	960	0
10	CIV	Bombadier Challenger 601	CF34-3A	4.42	0.22	4.13	0.51	1,697	0
11	CIV	Boeing 747-100	CF6-45A	0.01	0.02	0.01	0.01	8	0
11M	MIL	Desault Falcon 50	TFE731-3	0.00	0.00	0.00	0.00	0	0
14	CIV	Douglas DC-9	JT8D-7	0.08	0.02	0.07	0.04	38	0
15M	MIL	Boeing 707 320B	TF33-P-100	0.02	0.00	0.02	0.00	10	0
17	CIV	Aerospatiale SA-365N Dauphin	250B17B	9.96	0.19	9.92	0.23	3,715	0
18	CIV	Gulfstream I	Rda.7	0.00	0.00	0.00	0.00	1	0
19	CIV	De havalland DHC-6-100 Twin Otter	PT6A-20	2.53	0.02	2.52	0.03	934	0
20	CIV	Cessna 441	TPE331-8	4.97	0.11	4.97	0.12	1,862	0
20M	MIL	Cessna 441	TPE331-8	0.01	0.00	0.01	0.00	4	0
22	CIV	Israel IAI-1125 Astra	TFE731-2/2A	0.50	0.03	0.49	0.04	194	0
25	CIV	Cessna 650 Citation V	TFE731-3	0.16	0.01	0.16	0.01	62	0
21	CIV	Cessna 150 Series	O-200	172.08	0.38	171.80	0.67	28,023	35,098
21M	MIL	Cessna 150 Series	O-200	0.20	0.00	0.20	0.00	73	0
26	CIV	Falcon 50/900	TFE731-3	1.83	0.08	1.80	0.11	700	0
29	CIV	Beech King Air 90	PT6A-60	0.93	0.06	0.94	0.05	362	0
30	CIV	Saab 340	CT7-5A2	0.00	0.00	0.00	0.00	1	0
32	CIV	727-100	JT8D-15	0.00	0.00	0.00	0.00	1	0
33	CIV	SD 330 Sherpa	PT6A-45	0.92	0.04	0.90	0.05	350	0
34	CIV	Boeing 737-100 series Freighter	JT8D-17	0.07	0.00	0.05	0.01	24	0
35	CIV	Dornier 328-100	PW119B	0.02	0.00	0.02	0.00	9	0
36	CIV	Airbus A320 200 Series	CFM56-5B4/P	0.02	0.00	0.02	0.01	8	0
37	CIV	Bombadier Global Express	BR700-710A2-20	2.00	0.12	1.89	0.23	775	0
39	CIV	Gulfstream II	SPEY MK511-8	0.03	0.00	0.04	0.00	13	0
40	CIV	Cessna 750 Citation X	AE3007C TYPE 2	1.95	0.08	1.89	0.13	742	0
41	CIV	Boeing 737-800	CFM56-7B27	0.17	0.08	0.14	0.11	94	0
42	CIV	Boeing 757-200 Series	RB211-535E4	0.02	0.01	0.02	0.00	8	0
43	CIV	Eclipse 500	PW610F	1.74	0.09	1.66	0.17	672	0
44	CIV	Cessna 525C Citation Jet	JT15D-1	1.11	0.03	1.11	0.03	418	0
45	CIV	Cessna 560 Citation V	JT15D-5	1.05	0.02	1.05	0.03	395	0
46	CIV	Cessna 560 Citation Excel\	JT15D-5	2.76	0.12	2.73	0.15	1,055	0
47	CIV	Bombadier Learjet 60	TFE731-2/2A	0.83	0.04	0.82	0.05	320	0
48	CIV	Cessna 680 Citation Sovereign	PW306B	1.17	0.07	1.17	0.07	453	0
				225.88	2.72	224.46	4.14	48,567.8	35,098.0
				Arrivals	228.60	Departures	228.60		
						Total	457.19		

Note: Groups 21 and 21M are modeled with a mix of single engine piston aircraft: 75% GASEPF and 25% GASEPV.

305540 2012 Hanscom ESPR
INM Operation for Air Quality Analysis
2020 Operations
Average Annual Day

Group	Sector	EDMS	Engine Type	Departures		Arrivals		Annual	Annual
				Day	Night	Day	Night	LTOs	TGOs
1	CIV	Cessna 500 citation I	JT15D-1	0.87	0.05	0.85	0.08	338	0
2	CIV	Beechjet 400	JT15D-5	2.72	0.15	2.64	0.24	1,053	0
3	CIV	Bombadier Learjet 35	TFE731-2-2B	7.47	0.42	7.24	0.65	2,888	0
3M	MIL	Falcon 200	CF700-2D	0.24	0.00	0.24	0.00	89	0
8	CIV	Gulfstream IV	TAY MK611-8	5.32	0.30	5.16	0.46	2,058	0
9	CIV	Bombadier Challenger 600	ALF 502L-2	3.24	0.18	3.14	0.28	1,254	0
10	CIV	Bombadier Challenger 601	CF34-3A	6.29	0.36	6.10	0.55	2,433	0
15M	MIL	Boeing 707 320B	TF33-P-100	0.09	0.00	0.09	0.00	33	0
17	CIV	Aerospatiale SA-365N Dauphin	250B17B	10.03	0.20	10.00	0.23	3,743	0
19	CIV	De havalland DHC-6-100 Twin Otter	PT6A-20	3.10	0.07	3.08	0.09	1,160	0
20	CIV	Cessna 441	TPE331-8	5.17	0.12	5.16	0.12	1,936	0
20M	MIL	Cessna 441	TPE331-8	0.04	0.00	0.04	0.00	13	0
22	CIV	Israel IAI-1125 Astra	TFE731-2/2A	0.59	0.03	0.57	0.05	228	0
21	CIV	Cessna 150 Series	O-200	160.56	0.35	160.28	0.63	23,795	35,098
21M	MIL	Cessna 150 Series	O-200	0.65	0.00	0.65	0.01	239	0
26	CIV	Falcon 50/900	TFE731-3	2.40	0.14	2.32	0.21	927	0
29	CIV	Beech King Air 90	PT6A-60	0.97	0.04	0.96	0.05	369	0
33	CIV	SD 330 Sherpa	PT6A-45	0.96	0.04	0.95	0.05	367	0
37	CIV	Bombadier Global Express	BR700-710A2-20	2.73	0.15	2.65	0.24	1,057	0
40	CIV	Cessna 750 Citation X	AE3007C Type 2	2.84	0.16	2.75	0.25	1,097	0
41	CIV	Boeing 737-800	CFM56-7B27	0.47	0.03	0.46	0.04	183	0
43	CIV	Eclipse 500	PW610F	2.32	0.13	2.24	0.20	896	0
44	CIV	Cessna 525C Citation Jet	JT15D-1	1.70	0.10	1.65	0.15	658	0
45	CIV	Cessna 560 Citation V	JT15D-5	1.47	0.08	1.43	0.13	570	0
46	CIV	Cessna 560 Citation Excel	JT15D-5	3.87	0.22	3.75	0.34	1,497	0
47	CIV	Bombadier Learjet 60	TFE 731-2/2A	1.18	0.07	1.15	0.10	457	0
48	CIV	Cessna 680 Citation Sovereign	PW306B	1.77	0.10	1.72	0.15	685	0
				229.09	3.48	227.26	5.32	50,023.8	35,098.0
				Arrivals	232.57	Departures	232.57		
						Total	465.15		

Note: Groups 21 and 21M are modeled with a mix of single engine piston aircraft: 75% GASEPF and 25% GASEPV.

305540 2012 Hanscom ESPR
INM Operation for Air Quality Analysis
2030 Operations
Average Annual Day

Group	Sector	EDMS	Engine Type	Departures		Arrivals		Annual LTOs	Annual TGOs
				Day	Night	Day	Night		
1	CIV	Cessna 500 citation 1	JT15D-1	1.17	0.07	1.13	0.10	451	0
2	CIV	Beechjet 400	JT15D-5	3.64	0.21	3.53	0.32	1,406	0
3	CIV	Bombadier Learjet 35	TFE731-2-2B	10.00	0.57	9.69	0.87	3,856	0
3M	MIL	Falcon 200	CF700-2D	0.24	0.00	0.24	0.00	89	0
8	CIV	Gulfstream IV	JAYMK611-8	7.13	0.40	6.91	0.62	2,748	0
9	CIV	Bombadier Challenger 600	ALF502L-2	4.34	0.25	4.21	0.38	1,674	0
10	CIV	Bombadier Challenger 601	CF34-3A	8.42	0.48	8.16	0.74	3,248	0
15M	MIL	Boeing 707 320B	TF33-P-100	0.09	0.00	0.09	0.00	33	0
17	CIV	Aerospatiale SA-365N Dauphin	250B17B	10.06	0.20	10.02	0.23	3,743	0
19	CIV	De havalland DHC-6-100 Twin Otter	PT6A-20	4.38	0.79	4.36	0.10	1,757	0
20	CIV	Cessna 441	TPE331-8	5.84	0.13	5.83	0.14	2,180	0
20M	MIL	Cessna 441	TPE331-8	0.04	0.00	0.04	0.00	13	0
22	CIV	Israel IAI-1125 Astra	TFE731-2/2A	0.79	0.04	0.77	0.07	305	0
21	CIV	Cessna 150 Series	O-200	176.78	0.44	176.44	0.78	29,585	35,098
21M	MIL	Cessna 150 Series	O-200	0.65	0.00	0.65	0.01	239	0
26	CIV	Falcon 50/900	TFE731-3	3.21	0.18	3.11	0.28	1,237	0
29	CIV	Beech King Air 90	PT6A-60	1.04	0.04	1.02	0.06	394	0
33	CIV	SD 330 Sherpa	PT6A-45	1.08	0.04	1.07	0.06	412	0
37	CIV	Bombadier Global Express	BR700-710A2-20	3.66	0.21	3.54	0.32	1,410	0
40	CIV	Cessna 750 Citation X	AE3007C TYPE 2	3.80	0.21	3.68	0.33	1,464	0
41	CIV	Boeing 737-800	CFM56-7B27	0.63	0.04	0.61	0.06	244	0
43	CIV	Eclipse 500	PW610F	3.10	0.18	3.01	0.27	1,196	0
44	CIV	Cessna 525C Citation Jet	JT15D-1	2.28	0.13	2.21	0.20	878	0
45	CIV	Cessna 560 Citation V	JT15D-5	1.97	0.11	1.91	0.17	761	0
46	CIV	Cessna 560 Citation Excel\	JT15D-5	5.18	0.29	5.02	0.45	1,999	0
47	CIV	Bombadier Learjet 60	TFE731-2/2A	1.58	0.09	1.53	0.14	610	0
48	CIV	Cessna 680 Citation Sovereign	PW306B	2.37	0.13	2.30	0.21	915	0
				263.48	5.22	261.09	6.90	62,848.0	35,098.0
				Arrivals	268.70	Departures	267.99		
						Total	536.69		

Note: Groups 21 and 21M are modeled with a mix of single engine piston aircraft: 75% GASEPF and 25% GASEPV.

Hanscom ESPR
2012 Mesoscale Analysis - Hanscom Traffic

Link	Distance (miles)	AM Peak	PM Peak	ADT	Daily VMT	Vehicle Speeds (mph)	Vehicle Emission Factors 2012					
							CO (g/mile)	CO2 (g/mile)	VOC (g/mile)	NOX (g/mile)	PM10 (g/mile)	PM2.5 (g/mile)
Airport Road	0.32	0	0	0	0	30	10.143	561.3	0.329	0.758	0.0358	0.0204
Bedford Road	0.35	12	18	180	63	35	10.15	561.3	0.313	0.751	0.0358	0.0204
Concord Trnpke	0.6	25	22	250	150	40	10.714	561.3	0.303	0.803	0.0358	0.0204
Hanscom Drive	0.65	125	107	1250	812.5	30	10.143	561.3	0.329	0.758	0.0358	0.0204
Hartwell Ave	1.24	10	5	100	124	40	10.714	561.3	0.303	0.803	0.0358	0.0204
Hartwell Road	1.62	0	0	0	0	25	10.294	561.3	0.352	0.785	0.0358	0.0204
Mass Ave	0.36	12	9	120	43.2	35	10.15	561.3	0.313	0.751	0.0358	0.0204
Old Bedford Road 1	0.31	3	2	30	9.3	30	10.143	561.3	0.329	0.758	0.0358	0.0204
Old Bedford Road 2	0.49	37	9	370	181.3	30	10.143	561.3	0.329	0.758	0.0358	0.0204
Old Mass Ave	0.53	10	5	100	53	35	10.15	561.3	0.313	0.751	0.0358	0.0204
Route 2A (1)	0.46	45	16	450	207	40	10.714	561.3	0.303	0.803	0.0358	0.0204
Route 2A (2)	1.67	23	16	230	384.1	40	10.714	561.3	0.303	0.803	0.0358	0.0204
Route 2A (3)	1.08	48	38	480	518.4	40	10.714	561.3	0.303	0.803	0.0358	0.0204
Route 2A (4)	0.23	60	56	600	138	40	10.714	561.3	0.303	0.803	0.0358	0.0204
Route 2A (5)	0.92	125	51	1250	1150	40	10.714	561.3	0.303	0.803	0.0358	0.0204
Route 2A (6)	0.11	65	53	650	71.5	40	10.714	561.3	0.303	0.803	0.0358	0.0204
Route 2A (7)	0.15	55	46	550	82.5	40	10.714	561.3	0.303	0.803	0.0358	0.0204
Route 2A (8)	0.18	43	37	430	77.4	40	10.714	561.3	0.303	0.803	0.0358	0.0204
Route 62 (1)	1.46	0	0	0	0	35	10.15	561.3	0.313	0.751	0.0358	0.0204
Route 62 (2)	1.64	15	9	150	246	35	10.15	561.3	0.313	0.751	0.0358	0.0204
Route 62 (3)	1.12	15	9	150	168	30	10.143	561.3	0.329	0.758	0.0358	0.0204
Route 4/225 (1)	2.1	0	0	0	0	35	10.15	561.3	0.313	0.751	0.0358	0.0204
Route 4/225 (2)	0.56	2	2	20	11.2	40	10.714	561.3	0.303	0.803	0.0358	0.0204
Route 4/225 (3)	0.16	0	0	0	0	25	10.294	561.3	0.352	0.785	0.0358	0.0204
South Road (1)	0.58	0	0	0	0	30	10.143	561.3	0.329	0.758	0.0358	0.0204
South Road (2)	0.85	0	0	0	0	30	10.143	561.3	0.329	0.758	0.0358	0.0204
Virginia Road	2.13	23	9	230	489.9	30	10.143	561.3	0.329	0.758	0.0358	0.0204

1. AM and PM peak volumes are Hanscom Traffic only.
2. ADT based on worst case AM or PM hours which represent approximately 10 percent of daily traffic.
3. Vehicle emissions in kg/yr were based on daily emissions and scaled by 365 days.
4. Total kg/1000 kg were divided by 1,000 for consistency with 2005 ESPR.

**Hanscom ESPR
2020 Mesoscale Analysis - Hanscom Traffic**

Link	Distance (miles)	AM Peak	PM Peak	ADT	Daily VMT	Vehicle Speeds (mph)	Vehicle Emission Factors 2020					
							CO (g/mile)	CO2 (g/mile)	VOC (g/mile)	NOX (g/mile)	PM10 (g/mile)	PM2.5 (g/mile)
Airport Road	0.32	0	0	0	0	30	8.593	569.37	0.212	0.263	0.0285	0.0137
Bedford Road	0.35	16	24	240	84	35	8.601	569.37	0.2	0.26	0.0285	0.0137
Concord Trnpke	0.6	30	30	300	180	40	8.835	569.37	0.192	0.267	0.0285	0.0137
Hanscom Drive	0.65	167	149	1670	1085.5	30	8.593	569.37	0.212	0.263	0.0285	0.0137
Hartwell Ave	1.24	13	6	130	161.2	40	8.835	569.37	0.192	0.267	0.0285	0.0137
Hartwell Road	1.62	0	0	0	0	25	8.708	569.37	0.229	0.272	0.0285	0.0137
Mass Ave	0.36	16	12	160	57.6	35	8.601	569.37	0.2	0.26	0.0285	0.0137
Old Bedford Road 1	0.31	5	6	60	18.6	30	8.593	569.37	0.212	0.263	0.0285	0.0137
Old Bedford Road 2	0.49	50	11	500	245	30	8.593	569.37	0.212	0.263	0.0285	0.0137
Old Mass Ave	0.53	13	6	130	68.9	35	8.601	569.37	0.2	0.26	0.0285	0.0137
Route 2A (1)	0.46	59	22	590	271.4	40	8.835	569.37	0.192	0.267	0.0285	0.0137
Route 2A (2)	1.67	31	22	310	517.7	40	8.835	569.37	0.192	0.267	0.0285	0.0137
Route 2A (3)	1.08	65	52	650	702	40	8.835	569.37	0.192	0.267	0.0285	0.0137
Route 2A (4)	0.23	81	77	810	186.3	40	8.835	569.37	0.192	0.267	0.0285	0.0137
Route 2A (5)	0.92	87	70	870	800.4	40	8.835	569.37	0.192	0.267	0.0285	0.0137
Route 2A (6)	0.11	87	70	870	95.7	40	8.835	569.37	0.192	0.267	0.0285	0.0137
Route 2A (7)	0.15	73	63	730	109.5	40	8.835	569.37	0.192	0.267	0.0285	0.0137
Route 2A (8)	0.18	57	59	590	106.2	40	8.835	569.37	0.192	0.267	0.0285	0.0137
Route 62 (1)	1.46	0	5	50	73	35	8.601	569.37	0.2	0.26	0.0285	0.0137
Route 62 (2)	1.64	19	11	190	311.6	35	8.601	569.37	0.2	0.26	0.0285	0.0137
Route 62 (3)	1.12	19	11	190	212.8	30	8.593	569.37	0.212	0.263	0.0285	0.0137
Route 4/225 (1)	2.1	3	0	30	63	35	8.601	569.37	0.2	0.26	0.0285	0.0137
Route 4/225 (2)	0.56	0	3	30	16.8	40	8.835	569.37	0.192	0.267	0.0285	0.0137
Route 4/225 (3)	0.16	0	0	0	0	25	8.708	569.37	0.229	0.272	0.0285	0.0137
South Road (1)	0.58	0	0	0	0	30	8.601	569.37	0.212	0.263	0.0285	0.0137
South Road (2)	0.85	0	0	0	0	30	8.601	569.37	0.212	0.263	0.0285	0.0137
Virginia Road	2.13	45	11	450	958.5	30	8.601	569.37	0.212	0.263	0.0285	0.0137

1. AM and PM peak volumes are Hanscom Traffic only.
2. ADT based on worst case AM or PM hours which represent approximately 10 percent of daily traffic.
3. Vehicle emissions in kg/yr were based on daily emissions and scaled by 365 days.
4. Total kg/1000 kg were divided by 1,000 for consistency with 2005 ESPR.

Hanscom ESPR
2030 Mesoscale Analysis - Hanscom Traffic

Link	Distance (miles)	AM Peak	PM Peak	ADT	Daily VMT	Vehicle Speeds (mph)	Vehicle Emission Factors 2030					
							CO (g/mile)	CO2 (g/mile)	VOC (g/mile)	NOX (g/mile)	PM10 (g/mile)	PM2.5 (g/mile)
Airport Road	0.32	0	0	0	0	30	8.313	569.4	0.192	0.166	0.0274	0.0127
Bedford Road	0.35	27	48	480	168	35	8.321	569.4	0.181	0.163	0.0274	0.0127
Concord Trnpke	0.6	62	60	620	372	40	8.548	569.4	0.173	0.168	0.0274	0.0127
Hanscom Drive	0.65	291	296	2960	1924	30	8.313	569.4	0.192	0.166	0.0274	0.0127
Hartwell Ave	1.24	25	13	250	310	40	8.548	569.4	0.173	0.168	0.0274	0.0127
Hartwell Road	1.62	0	0	0	0	25	8.42	569.4	0.208	0.172	0.0274	0.0127
Mass Ave	0.36	27	25	270	97.2	35	8.321	569.4	0.181	0.163	0.0274	0.0127
Old Bedford Road 1	0.31	10	14	140	43.4	30	8.313	569.4	0.192	0.166	0.0274	0.0127
Old Bedford Road 2	0.49	82	27	820	401.8	30	8.313	569.4	0.192	0.166	0.0274	0.0127
Old Mass Ave	0.53	25	13	250	132.5	35	8.321	569.4	0.181	0.163	0.0274	0.0127
Route 2A (1)	0.46	102	44	1020	469.2	40	8.548	569.4	0.173	0.168	0.0274	0.0127
Route 2A (2)	1.67	53	44	530	885.1	40	8.548	569.4	0.173	0.168	0.0274	0.0127
Route 2A (3)	1.08	115	104	1150	1242	40	8.548	569.4	0.173	0.168	0.0274	0.0127
Route 2A (4)	0.23	141	152	1520	349.6	40	8.548	569.4	0.173	0.168	0.0274	0.0127
Route 2A (5)	0.92	151	143	1510	1389.2	40	8.548	569.4	0.173	0.168	0.0274	0.0127
Route 2A (6)	0.11	151	123	1510	166.1	40	8.548	569.4	0.173	0.168	0.0274	0.0127
Route 2A (7)	0.15	100	129	1290	193.5	40	8.548	569.4	0.173	0.168	0.0274	0.0127
Route 2A (8)	0.18	0	11	110	19.8	40	8.548	569.4	0.173	0.168	0.0274	0.0127
Route 62 (1)	1.46	34	27	340	496.4	35	8.321	569.4	0.181	0.163	0.0274	0.0127
Route 62 (2)	1.64	34	27	340	557.6	35	8.321	569.4	0.181	0.163	0.0274	0.0127
Route 62 (3)	1.12	7	0	70	78.4	30	8.313	569.4	0.192	0.166	0.0274	0.0127
Route 4/225 (1)	2.1	0	4	40	84	35	8.321	569.4	0.181	0.163	0.0274	0.0127
Route 4/225 (2)	0.56	0	0	0	0	40	8.548	569.4	0.173	0.168	0.0274	0.0127
Route 4/225 (3)	0.16	0	0	0	0	25	8.42	569.4	0.208	0.172	0.0274	0.0127
South Road (1)	0.58	0	0	0	0	30	8.313	569.4	0.192	0.166	0.0274	0.0127
South Road (2)	0.85	0	0	0	0	30	8.313	569.4	0.192	0.166	0.0274	0.0127
Virginia Road	2.13	83	27	830	1767.9	30	8.313	569.4	0.192	0.166	0.0274	0.0127

1. AM and PM peak volumes are Hanscom Traffic only.
2. ADT based on worst case AM or PM hours which represent approximately 10 percent of daily traffic.
3. Vehicle emissions in kg/yr were based on daily emissions and scaled by 365 days.
4. Total kg/1000 kg were divided by 1,000 for consistency with 2005 ESPR.

Appendix F Wetlands and Rare Species



MassWildlife

Commonwealth of Massachusetts

Division of Fisheries & Wildlife

Wayne F. MacCallum, *Director*

January 31, 2013

Chris McCarthy
CH2M HILL
18 Tremont Street
Suite 700
Boston MA 02108

RE: Project Location: Hanscom Field
Town: BEDFORD, CONCORD, LEXINGTON, LINCOLN
NHESP Tracking No.: 06-19316

To Whom It May Concern:

Thank you for contacting the Natural Heritage and Endangered Species Program ("NHESP") of the MA Division of Fisheries & Wildlife for information regarding state-listed rare species in the vicinity of the above referenced site. Based on the information provided, this project site, or a portion thereof, is located **within** Priority Habitat 300 (PH 300) as indicated in the *Massachusetts Natural Heritage Atlas* (13th Edition). Our database indicates that the following state-listed rare species have been found in the vicinity of the site:

<u>Scientific name</u>	<u>Common Name</u>	<u>Taxonomic Group</u>	<u>State Status</u>
<i>Bartramia longicauda</i>	Upland Sandpiper	Bird	Endangered
<i>Ammodramus savannarum</i>	Grasshopper Sparrow	Bird	Threatened
<i>Emydoidea blandingii</i>	Blanding's Turtle	Reptile	Threatened
<i>Glyptemys insculpta</i>	Wood Turtle	Reptile	Special Concern

The species listed above are protected under the Massachusetts Endangered Species Act (MESA) (M.G.L. c. 131A) and its implementing regulations (321 CMR 10.00). State-listed wildlife are also protected under the state's Wetlands Protection Act (WPA) (M.G.L. c. 131, s. 40) and its implementing regulations (310 CMR 10.00). Fact sheets for most state-listed rare species can be found on our website (www.nhesp.org).

Please note that projects and activities located within Priority and/or Estimated Habitat **must** be reviewed by the NHESP for compliance with the state-listed rare species protection provisions of MESA (321 CMR 10.00) and/or the WPA (310 CMR 10.00).

Wetlands Protection Act (WPA)

If the project site is within Estimated Habitat and a Notice of Intent (NOI) is required, then a copy of the NOI must be submitted to the NHESP so that it is received at the same time as the local conservation commission. If the NHESP determines that the proposed project will adversely affect the actual Resource Area habitat of state-protected wildlife, then the proposed project may not be permitted (310 CMR 10.37, 10.58(4)(b) & 10.59). In such a case, the project proponent may request a consultation with the NHESP to discuss potential project design modifications that would avoid adverse effects to rare wildlife habitat.

www.masswildlife.org

Division of Fisheries and Wildlife

Temporary Correspondence: 100 Hartwell Street, Suite 230, West Boylston, MA 01583

Permanent: Field Headquarters, North Drive, Westborough, MA 01581 (508) 389-6300 Fax (508) 389-7890

An Agency of the Department of Fish and Game

A streamlined joint MESA/WPA review process is now available. When filing a Notice of Intent (NOI), the applicant may now file concurrently under the MESA on the same NOI form and qualify for a 30-day streamlined joint review. For a copy of the revised NOI form, please visit the MA Department of Environmental Protection's website: <http://www.mass.gov/dep/water/approvals/wpaform3.doc>.

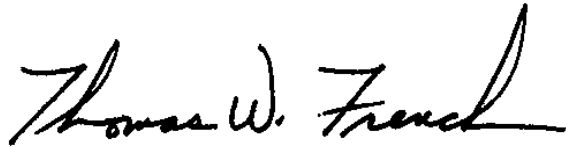
MA Endangered Species Act (MESA)

If the proposed project is located within Priority Habitat and is not exempt from review (see 321 CMR 10.14), then project plans, a fee, and other required materials must be sent to NHESP Regulatory Review to determine whether a probable "take" under the MA Endangered Species Act would occur (321 CMR 10.18). Please note that all proposed and anticipated development must be disclosed, as MESA does not allow project segmentation (321 CMR 10.16). For a MESA filing checklist and additional information please see our website: www.nhesp.org ("Regulatory Review" tab).

We recommend that rare species habitat concerns be addressed during the project design phase prior to submission of a formal MESA filing, as avoidance and minimization of impacts to rare species and their habitats is likely to expedite endangered species regulatory review.

This evaluation is based on the most recent information available in the Natural Heritage database, which is constantly being expanded and updated through ongoing research and inventory. If you have any questions regarding this letter please contact Eve Schluter, Endangered Species Review Biologist, at (508) 389-6346.

Sincerely,

A handwritten signature in black ink that reads "Thomas W. French". The signature is fluid and cursive, with the first letters of each name being capitalized and prominent.

Thomas W. French, Ph.D.
Assistant Director

MASSACHUSETTS RARE AND ENDANGERED WILDLIFE

UPLAND SANDPIPER (*Bartramia longicauda*)

DESCRIPTION

The Upland Sandpiper is a slender, moderate-sized shore-bird with a small head, large, shoe-button eyes, short and thin dark-brown bill, long, thin neck and relatively long tail. Legs are yellowish. It stands about 12 in (30 cm) tall and has a wingspan of 25 to 27 in (64 to 68 cm). The crown is dark brown with a pale buff crown stripe. The rump, upper tail and wings are much darker than the rest of the bird. Calls include a rapid "quip-ip-ip-ip" alarm call, and a long, drawn-out courtship call which has been described as a windy whistle, "whiiiiip-who-ee-oo". The sexes are similar. This species often poses with its wings up raised when alighting on utility poles or fence posts.



Hobbs, C.S., B. Brown, and H.S. Zim. *Birds of North America*. Golden Press, New York, 1964.

ECOLOGY/BEHAVIOR

Habitat in Massachusetts

The Upland Sandpiper inhabits large expanses of open grassy uplands, wet meadows, old fields, and pastures. In Massachusetts it is restricted to open expanses of grassy fields, hay fields, and mown grassy strips adjacent to runways and taxiways of airports and military bases. They need feeding and loafing areas as well as nesting areas. It winters in similar landscapes in South America.

Movement/territory/breeding behavior

The Upland Sandpiper returns to its breeding habitat in Massachusetts mid-April to early May. The birds arrive already paired and usually return to the same area year after year. Their courtship displays include circling flights by individual birds that last 5 to 15 minutes and reach as high as



(continued overleaf)



Range of *Bartramia longicauda*

- Verified since 1978
- Reported prior to 1978

Breeding Distribution in Massachusetts
by Town

1000 ft (305 m) during which they give their "windy whistle" call. On the ground, the male will raise his tail and run at his mate stopping suddenly. The nest is a grass-lined depression on the ground. It is well concealed by arched grasses making it invisible from above. Four, or occasionally 3 eggs are laid at 26 hour intervals. The eggs are pinkish-buff with fine brown spots. Both sexes incubate the eggs beginning after the clutch is complete. Renesting may occur if the initial clutch is destroyed.

Incubating adults are well-concealed and will tolerate close approach before flushing. The adults are secretive around the nest, approaching it from a distance by walking cautiously through the grass, head held low and squatting lower and lower. Unless flushed, the bird leaves the nest in the same manner. Each bird has a characteristic flushing distance. It becomes less willing to flush as the eggs begin to pip. The adults are very unlikely to abandon the nest even if repeatedly disturbed, but will immediately desert if the eggs are damaged. The chicks are downy and precocial at hatching and leave the nest very soon thereafter. One or both adults care for the chicks, watching for danger as the chicks catch insects and as they sleep. The young reach full size and adult plumage by the time they fledge at 32 to 34 days. The adults do not defend the nest or a nesting territory. They do however, drive other individuals and animals such as ground squirrels, away if they approach the young. This behavior diminishes as the young mature and disappears when the young fledge. After fledging, families and individuals begin to mix and form flocks. The Upland Sandpipers gather in increasingly large flocks in July and begin fall migration from Massachusetts in late July and August.

Feeding behavior

The Upland Sandpipers primarily pursue grasshoppers, crickets, weevils, beetles, ants, spiders, snails and earthworms on the ground. They chase the insects rapidly and even leap into the air in pursuit.

RANGE

The Upland Sandpiper breeds from Maine to central Canada and Alaska, Maryland to Oklahoma and Colorado. It breeds locally in Massachusetts. It winters in similar habitats in South America, particularly on the pampas of northern Argentina and Uruguay.

POPULATION STATUS

The Upland Sandpiper is classified as "Endangered" in Massachusetts. In 1985 a total of 35 to 37 breeding pairs nested at only 7 sites in the state.

European settlement created extensive nesting habitat through the clearing of the forest for agriculture and grazing. The Upland Sandpiper was common in the 1850's and at that time was seen in the thousands. Commercial shooting for food reduced its numbers dramatically. Currently, after having been protected from hunting for over sixty years, it is threatened by loss of habitat to development and succession of open lands to forest. The Upland Sandpiper is experiencing population decline over much of its range, particularly in the midwest and eastern United States.



Natural Heritage & Endangered Species
Program
Division of Fisheries & Wildlife
Route 135
Westborough, MA 01581
(508)792-7270, ext. 200

MASSACHUSETTS RARE AND ENDANGERED WILDLIFE GRASSHOPPER SPARROW

(*Ammodramis* *savannarum*)

DESCRIPTION

The Grasshopper Sparrow is a small sparrow of open fields. It is 4.5 to 5.5 in (11 - 13 cm) long with a narrow short tail. Each feather of the tail tapers to a point giving it a ragged appearance. It has a flat head which slopes directly into the bill. The unstreaked throat and breast are bright buff colored. The upperparts have reddish streaks which contrast with the intervening gray. The dark brown crown is divided by a thin cream-colored center stripe. A yellowish spot extends from the bill in front and below the eye. The sexes are similar. The typical song, often mistaken for the song of a grasshopper, consists of two chip notes followed by "tsick tsick tsurrrrr". Breeding birds also sing a complicated song with many squeaky and buzzy notes intermixed in a long phrase.



Bocklin, C.S., B. Brown, and R.S. Elm. Birds of North America. Golden Press, New York, 1966.

Similar Species

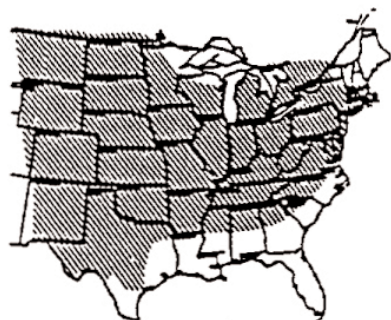
Young birds resemble adult Henslow's Sparrows but have dusky brown streaks or spots on the buffy breast and flanks. Adult Grasshopper Sparrows can be distinguished from the Field Sparrow by the latter's pinkish bill, rusty cap and white eye ring. Other species similar in appearance and also found in the same type of habitat include the Vesper Sparrow, Savannah Sparrow and Song Sparrow but Grasshopper Sparrow differs from these by its buffy unstreaked throats and breasts and the yellowish area around the eye. However, its distinctive call best distinguishes it from all other birds.

ECOLOGY/BEHAVIOR

Grasshopper Sparrows eat, sleep and nest on the ground. When flushed, it usually flies up from the grass, flutters rather low and erratically for a short distance and drops into the grass again. On the ground it either hops or runs.

Habitat in Massachusetts

It is found in sandplain grasslands, pastures, hayfields and airfields characterized by bunch grasses (rather than sod forming grasses). It is



Range of *Ammodramis* *savannarum*

(continued overleaf)



- Verified since 1978
- Reported prior to 1978

Breeding Distribution in Massachusetts
by Town

also found in open knolls, sandplains within Pine Barrens and coastal heathlands. It requires a patchy grassland habitat with bare ground and bunch grasses such as poverty grass (*Danthonia spicata*), bluestem (*Andropogon* spp.) and fescue (*Fescue* spp). Preferred habitat is characterized by relatively low stem densities and limited accumulation of ground litter. This species is generally absent from fields with over 35% cover in shrubs. Bare ground is especially important, as Grass-hopper Sparrows behave much like field mice in their habit of running along the ground to escape predators and to forage for invertebrates.

Migration

The Grasshopper Sparrows arrive in Massachusetts in late May. The male lays claim to a 1-4 acre exclusive non-overlapping territory by singing the "grass-hopper" song all day from a tall weed, fence post, haystack, etc. During the non-breeding season both the male and female sing. Grasshopper Sparrows migrate to the wintering grounds by mid-September.

Breeding habits

Grasshopper Sparrows produce one brood each summer in Massachusetts. The well-hidden nests are walled, domed structures of grasses built at the base of clumps of grass. Only the female incubates the eggs, which take an estimated 12 days to hatch. The usual 3-5 eggs are white with spots or blotches of brown to reddish brown which are concentrated on the larger end of the egg. The young, which are wholly dependent on the mother at hatching, leave the nest after 9 days and follow the parent on the ground until they fledge. If found on the nest, the mother flutters through the grass feigning lameness. Though the male does not care for the young, he does react to predators near the nest. Nests may be parasitized by cowbirds. Breeding activity diminishes by mid-August after which the families disperse.

Feeding Habits

This species is largely insectivorous. Patches of bare ground are critical to this sparrow's foraging behavior as grasshoppers, a primary food item, are most often pursued on or near the ground. Grasshopper Sparrows also feed on spiders, myriapods, snails, earthworms, weed and grass seeds.

RANGE

The Grasshopper Sparrow can be found from New Hampshire to California, and south to South Carolina to Mexico, Cuba, the Bahama's and Guatemala. It winters from southern California, southern Arizona, Oklahoma, Arkansas, Tennessee and North Carolina to El Salvador, and the West Indies.

POPULATION STATUS

The Grasshopper Sparrow is classified as a species of Special Concern in Massachusetts, where it is known to nest at less than 20 sites. Many of the current locations are in fields adjacent to air fields. This sparrow formerly was abundant on Nantucket, Martha's Vineyard and in eastern Massachusetts. Loss of appropriate habitat to land development, changes in agricultural practices (early harvesting and fewer fallow fields) and natural succession (abandoned fields growing up to shrubs and woods) appears to be the primary factor in its decline. Openings created by forest fires once provided habitat but these are now rare.



Natural Heritage & Endangered Species Program

Massachusetts Division of Fisheries & Wildlife
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www.nhesp.org

DESCRIPTION: The Blanding's Turtle is a mid-sized turtle ranging between 16 and 22 cm (6-9 in.) in shell length. Its high-domed carapace (top shell) is dark and covered with pale yellow flecking. The lower shell (plastron) is yellow with large black blotches on the outer posterior corner of each scute (scale). The plastron is hinged, allowing movement; however, the shell does not close tightly. In older individuals, the entire plastron may be black. The most distinguishing feature is its long, yellow throat and chin, which makes it recognizable at a distance. Males have slightly concave plastrons, females have flat plastrons. The tails of males are thicker and their cloacal opening (the common orifice of the digestive, reproductive and urinary systems) is located beyond the edge of the carapace. Hatchlings have a brown carapace and brown to black plastron, and range between 3.4 and 3.7 cm (1.3-1.5 in.) in length.

SIMILAR SPECIES: This species could be confused with the Eastern Box Turtle (*Terrapene carolina*). The Eastern Box Turtle can have a yellow chin but lacks the yellow throat and neck. Box Turtles are smaller, 10-18 cm (4-7 in.) in shell length. In addition, the Box Turtle has a prominent mid-line ridge (keel) on the carapace, which is absent on Blanding's Turtles. The Blanding's Turtle may also be confused with the Spotted Turtle. However, The Spotted Turtle is much smaller, 3.5-4.5 inches in length and has very distinct round yellow spots.

HABITAT IN MASSACHUSETTS: Blanding's Turtles use a variety of wetland and terrestrial habitat types. Blanding's Turtles have been observed in seasonal pools, marshes, scrub-shrub wetlands and open uplands (Sievert et al. 2003). Habitat use appears to vary according to the individual and the amount of precipitation, with more upland utilization during dry years (Joyal et al. 2001). Wetlands are used for overwintering during their inactive season (Nov-Mar).

Blanding's Turtle *Emydoidea blandingii*

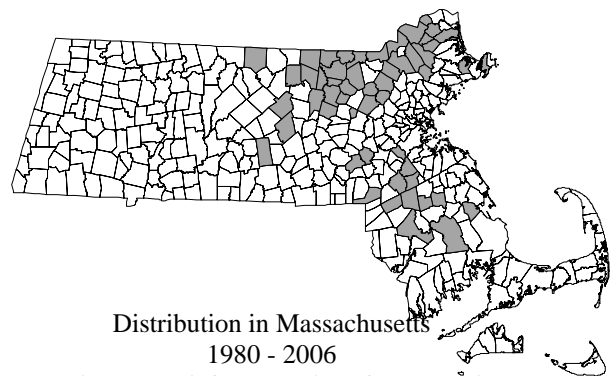
State Status: **Threatened**

Federal Status: None



Photo by Susan Speak

RANGE: The Blanding's Turtle is found primarily in the Great Lakes region, extending to Kansas. Several smaller, disjunct populations occur in the East: in southern Nova Scotia, in an arc extending from eastern Massachusetts through southeastern New Hampshire to southern Maine, and in the lower Hudson Valley of New York. These populations (with the exception of those in New Hampshire) are all listed as Threatened or Endangered at the state or provincial level.



Distribution in Massachusetts
1980 - 2006
Based on records in Natural Heritage Database

LIFE CYCLE & BEHAVIOR: Blanding's Turtles overwinter in organic substrate in the deepest parts of marshes, ponds, and occasionally, vernal pools. Some individuals overwinter under hummocks in red maple or highbush blueberry swamps. Upon emergence from overwintering, Blanding's Turtles often leave permanent wetlands and move overland to vernal pools and scrub-shrub swamps, where they feed and mate. It is during the summer months that females estivate in upland forest or along forest/field edges. At night and during periods of hot weather, Blanding's Turtles retreat to "forms". These small terrestrial shelters are found beneath leaf litter, in the grass, under logs or brush located up to 110 m (361 ft) from the nearest wetland. They are called "forms" because when the turtle leaves them, they retain the shape of the turtle's shell.

Blanding's Turtles are omnivores, eating both plants and animals. They eat while on land and in the water. The animals Blanding's Turtles are known to eat, either alive or as carrion, consist of Pulmonate snails, crayfish, earthworms, insects, golden shiners, brown bullheads, and other small vertebrates. Vernal pools are an important source of many of these prey items. The plants that Blanding's Turtles have been known to eat include coontail, duckweed, bulrush, and sedge.

Courtship and mating takes place during the spring and early summer and typically occurs in water. Baker and Gillingham (1983) reported that in seminatural conditions male Blanding's Turtles exhibit a variety of behaviors during mating including: chasing, mounting, chinning, gulping, swaying, violent swaying, and snorkeling. Chinning occurs after the male is mounted, if the female moves forward the male will start gulping (taking in water and expelling it over the female's head). Gulping is typically followed by swaying and escalates to violent swaying if the female remains motionless.

Females will remain in wetland or vernal pool habitat until they begin nesting. The majority of nesting occurs in June in open areas with well-drained loamy or sandy soils, such as: dirt roads, powerline right-of-ways, residential lawns, gravel pits and early successional fields. Female Blanding's Turtles reach sexual maturity at 14-20 years of age (Congdon *et al.*, 1993; Congdon and van Loben Sels, 1993) and may travel great distances, often more than 1 km (3280 ft), to find appropriate nesting habitat (Grgurovic and Sievert, 2005). Females typically begin nesting during the daylight and continue the process until after dark.

Blanding's Turtles display temperature-dependent sex determination; eggs incubated below a pivotal temperature that lies between 26.5°C and 30°C (79.7-86°F) produce males, and higher temperatures produce females (Ewert and Nelson 1991). Typical clutch size ranges from 10 to 12 eggs. Hatchlings emerge in the late August and September. The typical size of a hatchling is about 3.5 cm (1.4 in.) and 10 g (0.35 oz).

ACTIVE PERIOD

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

THREATS: Blanding's Turtles are particularly vulnerable because they travel very long distances during their active season, do not reproduce until late in life (14-20 yrs), and have low nest and juvenile survivorship. These traits make them extremely sensitive to even a 1-2% increase in adult mortality. Roads are the primary cause of adult mortality. Blanding's Turtles travel to multiple wetlands throughout a single year (typically 3-6) and adult females travel to nesting habitats, crossing roads in the process.

As this turtle is relatively difficult to study, it is not known how great a decline this species has experienced. In Massachusetts, few nesting sites are currently known and a variety of factors are attributed to this species' low numbers. Habitat loss, degradation, and fragmentation (i.e. roads) are driven by human activities such as commercial and residential expansion. Other threats include illegal collection, unnaturally inflated rates of predation in suburban and urban areas, agricultural and forestry practices, and natural succession (i.e. loss of nesting habitat).

MANAGEMENT RECOMMENDATIONS:

Using a turtle habitat model developed by UMass and NHESP records, Blanding's Turtle habitat needs to be assessed and prioritized for protection based on the extent, quality, and juxtaposition of habitats and their predicted ability to support self-sustaining populations of Blanding's Turtles. Other considerations should include the size and lack of fragmentation of both wetland and upland habitats and proximity and connectivity to other relatively unfragmented habitats, especially within existing protected open space.

Given limited conservation funds, alternatives to outright purchase of conservation land is an important component to the conservation strategy. These can include Conservation Restrictions (CRs) and Agricultural Preservation Restrictions (APRs). Another method of protecting large blocks of land is through the regulatory process by allowing the building of small or clustered roadside developments in conjunction with the protection of large areas of unimpacted land.

Habitat management and restoration guidelines should be developed and implemented in order to create and/or maintain consistent access to nesting habitat at key sites. This is most practical on state-owned conservation lands (i.e. DFW, DCR).

However, educational materials should be made available to guide private land owners on appropriate management practices for Blanding's Turtle habitat.

Alternative wildlife corridor structures should be considered at strategic sites on existing roads. In particular, appropriate wildlife corridor structures should be considered for bridge and culvert upgrade and road-widening projects within Blanding's Turtle Habitat. Efforts should be made to inform Mass Highways of key locations where these measures would be most effective for turtle conservation.

Educational materials are being developed and distributed to the public in reference to the detrimental effects of keeping our native turtles as pets (an illegal activity that reduces reproduction in the population), releasing pet store turtles (which could spread disease), leaving cats and dogs outdoors unattended (particularly during the nesting season), feeding suburban wildlife (which increases numbers of natural predators to turtles), and driving ATVs in nesting areas from June-October. People should be encouraged, when safe to do so, to help Blanding's Turtles cross roads (always in the direction the animal was heading); however turtles should never be transported to "better" locations. They will naturally want to return to their original location and likely need to traverse roads to do so.

Increased law enforcement is needed to protect our wild populations, particularly during the nesting season when poaching is most frequent and ATV use is common and most damaging.

Forestry Conservation Management Practice guidelines should be applied on state and private lands to avoid direct turtle mortality. Seasonal timber harvesting restrictions apply to Blanding's Turtle habitat and to stands with wetlands. Motorized vehicle access to timber harvesting sites in Blanding's Turtle habitat is restricted to times when the Blanding's Turtle is overwintering. Hand felling in wetland areas is required in order to maintain structural integrity of overwintering sites.

Finally, a statewide monitoring program is needed to track long-term population trends in Blanding's Turtles.

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Natural Heritage & Endangered Species Program

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DESCRIPTION: The Wood Turtle is a medium-sized turtle (14-20 cm; 5.5-8 in) that can be recognized by its sculpted shell and orange coloration on the legs and neck. The carapace (upper shell) is rough and each scale (scute) rises upwards in an irregularly shaped pyramid of grooves and ridges. The carapace is tan, grayish-brown or brown, has a mid-line ridge (keel) and often has a pattern of black or yellow lines on the larger scutes. The plastron (lower shell) is yellow with oblong dark patches on the outer, posterior corner of each scute. The head is black, but may be speckled with faint yellow spots. The legs, neck, and chin can have orange to reddish coloration. Males have a concave plastron, thick tail, long front claws, and a wider and more robust head than females. Hatchlings have a dull-colored shell that is broad and low, a tail that is almost as long as their carapace and they lack orange coloration on the neck and legs.

SIMILAR SPECIES: The habitat of the Eastern Box Turtle (*Terrapene carolina*) and the Blanding's Turtle (*Emydoidea blandingii*) may overlap that of the Wood Turtle, but neither has the Wood Turtle's pyramidal shell segments. Unlike the Wood Turtle, the Box and Blanding's Turtle have hinged plastrons into which they can withdraw or partially withdraw if threatened. The Northern Diamond-backed Terrapin (*Malaclemys terrapin*) has a shell similar to that of the Wood Turtle. However, its skin is grey and it lives only near brackish water, which the Wood Turtle avoids.

RANGE: The Wood Turtle can be found throughout New England, north to Nova Scotia, west to eastern Minnesota, and south to northern Virginia. The Wood Turtle appears to be widespread in Massachusetts. However, it should be kept in mind that little is known about the status of local populations associated with the majority of these sightings. Most of the towns have fewer than 5 known occurrences.

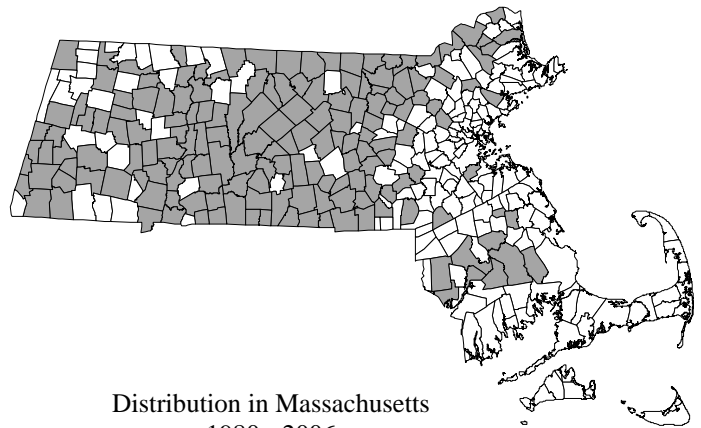
Wood Turtle *Glyptemys insculpta*

State Status: **Species of Special Concern**
Federal Status: None



Photo by Mike Jones

HABITAT IN MASSACHUSETTS: The preferred habitat of the Wood Turtle is riparian areas. Slower moving mid-sized streams are favored, with sandy bottoms and heavily vegetated stream banks. The stream bottom and muddy banks provide hibernating sites for overwintering, and open areas with sand or gravel substrate near the streams edge are used for nesting. Wood Turtles spend most of the spring and summer in mixed or deciduous forests, fields, hay-fields, riparian wetlands including wet meadows, bogs, and beaver ponds. Then they return to the streams in late summer or early fall to their favored overwintering location.



Distribution in Massachusetts
1980 - 2006
Based on records in Natural Heritage Database

LIFE CYCLE & BEHAVIOR: The Wood Turtle typically spends the winter in flowing rivers and perennial streams. Full-time submersion in the water begins in November, once freezing occurs regularly overnight, and continues until temperatures begin to increase in spring. It may hibernate alone or in large groups in community burrows in muddy banks, stream bottoms, deep pools, instream woody debris, and abandoned muskrat burrows. The Wood Turtle may make underwater movements in the stream during the winter; however, extended periods of activity and emergence from the water do not occur until mid-March or early April.

In spring, Wood Turtles are active during the day and are usually encountered within a few hundred meters from the stream banks. They have relatively linear home ranges that can be ½ a mile in length in Massachusetts (M. Jones, unpubl data). They will use emergent logs or grassy, sandy, and muddy banks to soak up the spring sun. During the summer months they feed in early successional fields, hayfields, and forests.

Wood Turtles are opportunistic omnivores; their diet consists of both plant and animal matter that is consumed on land and in the water. The Wood Turtle occasionally exhibits an unusual feeding behavior referred to as “stomping.” In its search for food, this species will stomp on the ground alternating its front feet, creating vibrations in the ground resembling rainfall. Earthworms respond, rising to the ground’s surface to keep from drowning. Instead of rain, the earthworm is met by the Wood Turtle, and is promptly devoured.

Although the peaks in mating activity occur in the spring and fall, Wood Turtles are known to mate opportunistically throughout their activity period. Males have been observed exhibiting aggressive behavior such as chasing, biting, and butting both during the mating season and at other times. A courtship ritual “dance” typically takes place at the edge of a stream or brook for several hours prior to mating. The dance involves the male and female approaching each other slowly with necks extended and their heads up. Before they actually touch noses, they lower their heads, and swing them from side to side. Copulation usually takes place within the water. Courting adults may produce a very subdued whistle that is rarely heard by observers. A female may mate with multiple individuals over the course of the active season.

In Massachusetts, most nesting occurs over a four-week period, primarily in June. Nesting sites may be a limited resource for Wood Turtles. Females are known to travel long distances in search of appropriate nesting habitat (average straight line distance of 244 m; 800 ft). Once they have arrived at a suitable nesting area, there may be multiple nesting attempts or false nests that occur over the course of several days, prior to laying eggs. They abort attempts when disturbed (e.g. by human activities) early in the process or hit a large rock while digging. Female Wood Turtles lay one clutch a year and often congregate in a good nesting area. Clutch size in Massachusetts averages 7 eggs (Jones, 2004, pers. comm.). Hatchling emergence occurs from August through September. The life span of the adult Wood Turtle is easily 46 years and may reach as much as 100 years.

ACTIVE PERIOD

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

THREATS: Hatchling and juvenile survival is very low and the time to sexual maturity is long. These characteristics are compensated by adults living a long time and reproducing for many years. Adult survivorship must be very high to sustain a viable population. These characteristics make Wood Turtles vulnerable to human disturbances. Population declines of Wood Turtles has likely been caused by hay-mowing operations, development of wooded stream banks, roadway casualties, incidental collection of specimens for pets, unnaturally inflated rates of predation in suburban and urban areas, forestry and agricultural activities and pollution of streams.

MANAGEMENT RECOMMENDATIONS: Using a turtle habitat model developed by UMass and NHESP records, Wood Turtle habitat needs to be assessed and prioritized for protection based on the extent, quality, and juxtaposition of habitats and their predicted ability to support self-sustaining populations of Wood Turtles. Other considerations should include the size and lack of fragmentation of both riverine and upland habitats and proximity and connectivity to other relatively unfragmented habitats, especially within existing protected open space. This information will be used to direct land acquisition and to target areas for Conservation Restrictions (CRs), Agricultural Preservation Restrictions (APRs) and Landowner Incentive Program (LIP) projects.

Mowing and nest site creation guidelines developed by NHESP should be followed on properties managed for Wood Turtles. These practices will be most practical on state-owned conservation lands. However, these materials are available to town land managers and private landowners.

Alternative wildlife corridor structures should be considered at strategic sites on existing roads. In particular, appropriate wildlife corridor structures should be considered for bridge and culvert upgrade and road-widening projects within or near Wood Turtle habitat. Efforts should be made to inform local regulatory agencies of key locations where these measures would be most effective for Wood Turtle conservation.

Educational materials are being developed and distributed to the public in reference to the detrimental effects of keeping our native Wood Turtles as pets (an illegal activity that reduces reproduction in the population), releasing pet store turtles (which could spread disease), leaving cats and dogs outdoors unattended (particularly during the nesting season), mowing of fields and shrubby areas, feeding suburban wildlife (which increases the number of natural predators to turtles), and driving ATVs in nesting areas from June-October. People should be encouraged, when safe to do so, to help Wood Turtles cross roads (always in the direction the animal was heading); however, turtles should never be transported to “better” locations. They will naturally want to return to their original location and likely need to traverse roads to do so.

Increased law enforcement is needed to protect our wild turtles, particularly during the nesting season when poaching is most frequent and ATV use is common and most damaging.

Forestry Conservation Management Practices should be applied on state and private lands to avoid direct turtle mortality. Seasonal timber harvesting restrictions apply to Wood Turtle habitat and to upland habitat that occurs up to 600 ft (183 m) beyond the stream edge. Motorized vehicle access to timber harvesting sites in Wood Turtle habitat is restricted to times when the Wood Turtle is overwintering. Bridges should be laid down across streams prior to any motorized equipment crossing the stream in order to maintain the structural integrity of overwintering sites.

Finally, a statewide monitoring program is needed to track long-term population trends in Wood Turtles.

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

New England Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5087
<http://www.fws.gov/newengland>



January 22, 2013

Reference: Project Location
2012 Hanscom Environmental Status and Planning Report Bedford, MA

Mr. Christopher J. McCarthy
CH2M Hill
18 Tremont Street, Suite 700
Boston, MA 02108

Dear Mr. McCarthy:

This responds to your recent correspondence requesting information on the presence of federally listed and/or proposed endangered or threatened species in relation to the proposed activity referenced above. These comments are provided in accordance with the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531, *et seq.*).

Based on information currently available to us, no federally listed or proposed, threatened or endangered species or critical habitat under the jurisdiction of the U.S. Fish and Wildlife Service are known to occur in the project area. Preparation of a Biological Assessment or further consultation with us under section 7 of the Endangered Species Act is not required. No further Endangered Species Act coordination is necessary for a period of one year from the date of this letter, unless additional information on listed or proposed species becomes available.

To obtain updated lists of federally listed or proposed threatened or endangered species and critical habitats, it is not necessary to contact this office. Instead, please visit the Endangered Species Consultation page on the New England Field Office's website:

www.fws.gov/newengland/endangeredspec-consultation.htm (accessed January 2013)

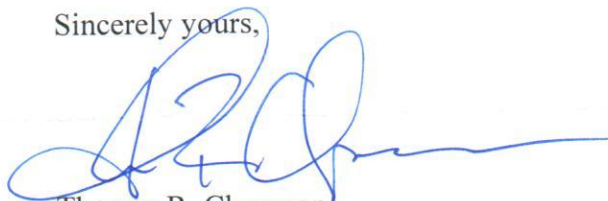
On the website, there is also a link to procedures that may allow you to conclude if habitat for a listed species is present in the project area. If no such habitat exists, then no federally listed species are present in the project area and there is no need to contact us for further consultation. If the above conclusion cannot be reached, further consultation with this office is advised. Information describing the nature and location of the proposed activity that should be provided to us for further informal consultation can be found at the above-referenced site.

Mr. Christopher J. McCarthy
January 22, 2013

2

Thank you for your coordination. Please contact Brett Hillman of this office at 603-223-2541, extension 34, if we can be of further assistance.

Sincerely yours,

A handwritten signature in blue ink, appearing to read 'T. Chapman', with a long horizontal flourish extending to the right.

Thomas R. Chapman
Supervisor
New England Field Office



L.G. Hanscom Field Grassland Management Program



Prepared by:

Massachusetts Port Authority
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Introduction

L.G. Hanscom Field (BED) is owned and operated by the Massachusetts Port Authority (Massport). The airport is situated on approximately 1,300 acres located in the towns of Bedford, Concord, Lexington and Lincoln, MA (Figure 1). Hanscom Field is primarily a general aviation airport, but also supports limited commercial operations and military flights. The airport consists of two paved runways, Runway 11/29 is 7,001 feet long and Runway 5/23 is 5,106 feet long. In 2003, Hanscom Field supported approximately 200,000 aircraft operations (landings and takeoffs). Nearly one-third of its annual operations are pilot training flights.

This *Grassland Management Program* outlines a series of guidelines for maintenance of portions of the grass infield areas between runways and taxiways at BED as well as selected grassed approach areas. **As noted throughout this document, the goal of grassland management must be carefully balanced with the airport's primary goal of maintaining aviation safety.** It is within the context of aviation safety that this program has been developed. As is discussed below, a key goal of the program is the reduction of wildlife hazards and evidence suggests that properly managed grasslands will support that aviation safety goal.

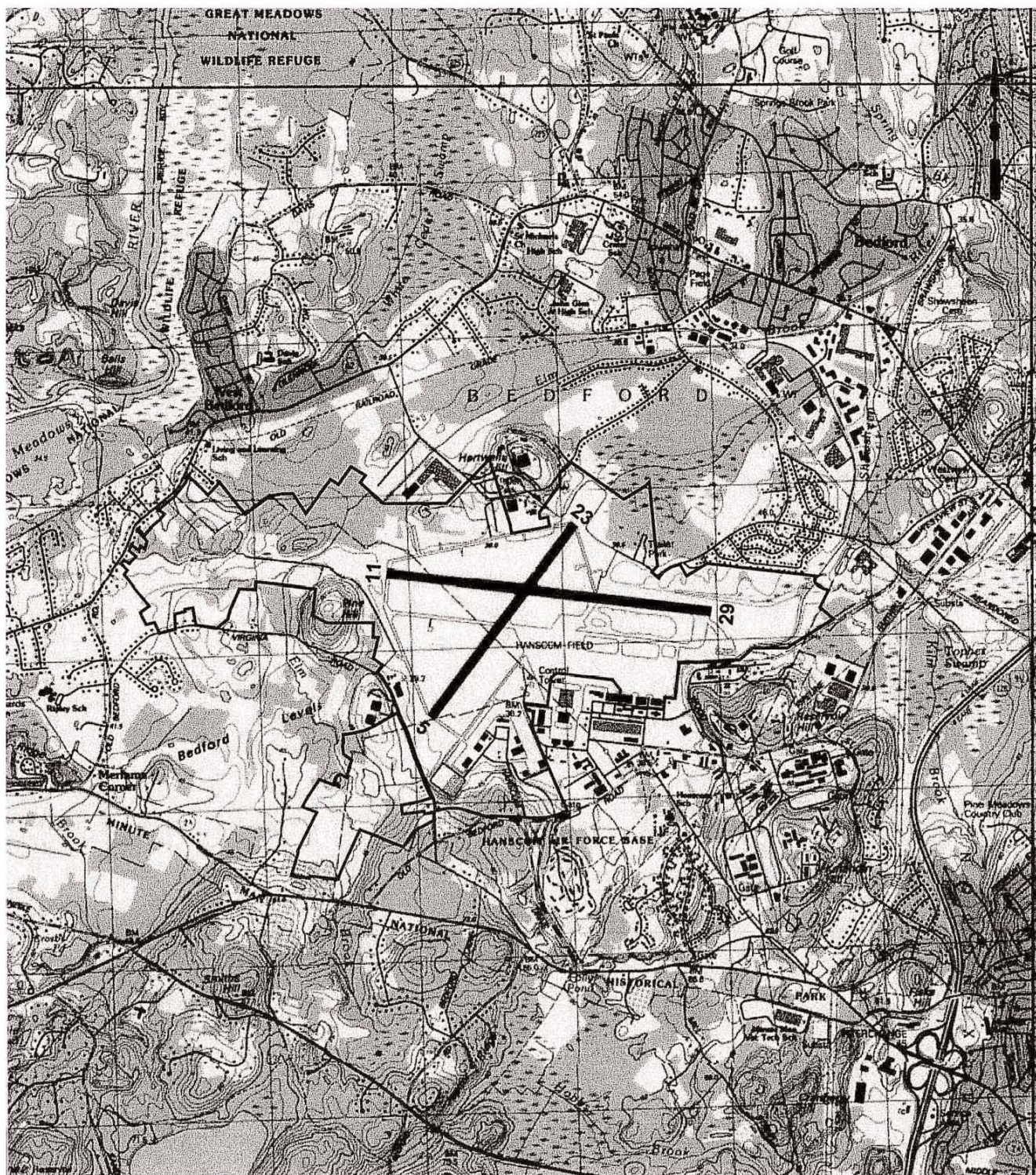
While Massport has taken a lead in the development of this program, finalization of the plan involved coordination with the U.S. Department of Agriculture/Wildlife Services, the Federal Aviation Administration (FAA), MA Natural Heritage and Endangered Species Program and MA Audubon.

Background

Grasslands are a vegetative community that is gradually disappearing in New England; a region that once supported vast natural and managed grasslands. This change is a result of natural succession, development, and the decline in farming. Many of the region's larger grasslands have historically supported large and diverse wildlife populations. As a result of the incremental loss of grasslands, many of these species are now at-risk.

Many airports maintain extensive grass infield areas between runways and taxiways; hence, airports often unintentionally provide some of the best, and last, grassland habitat in the region. This relationship can be a significant aviation safety concern, however, when there is an increase of the risk, frequency and potential severity of wildlife-aircraft collisions.

Similar to other airports in the Northeast, Hanscom Field has provided habitat for a number of grassland birds, several of which have been designated by the MA Natural Heritage and Endangered Species Program (NHESP) as threatened (T) or



**Grassland Management Program - Hanscom Field
Site Locus**

Figure 1

Source: USGS Quadrangle Maps for Billerica (1987), Reading (1987), Maynard (1987) and Boston North (1985)

endangered (E). These include the grasshopper sparrow (T) (*Ammodramus savannarum*) and the upland sandpiper (E) (*Bartramia longicauda*). Hanscom Field has also been observed to support other grassland bird species considered to be in decline, but not specifically protected by state or federal regulation.

Regulatory Context

Based upon information included in the NHESP *Massachusetts Natural Heritage Atlas (11th Edition, July 2003)*, substantial portions of Hanscom Field are identified as "Priority Habitats of Rare Species" (Figure 2). Certain activities within the habitats of rare species are subject to the MA Endangered Species Act (MESA) of 1990 and its implementing regulations of 1992 (MGL Chapter 131A).

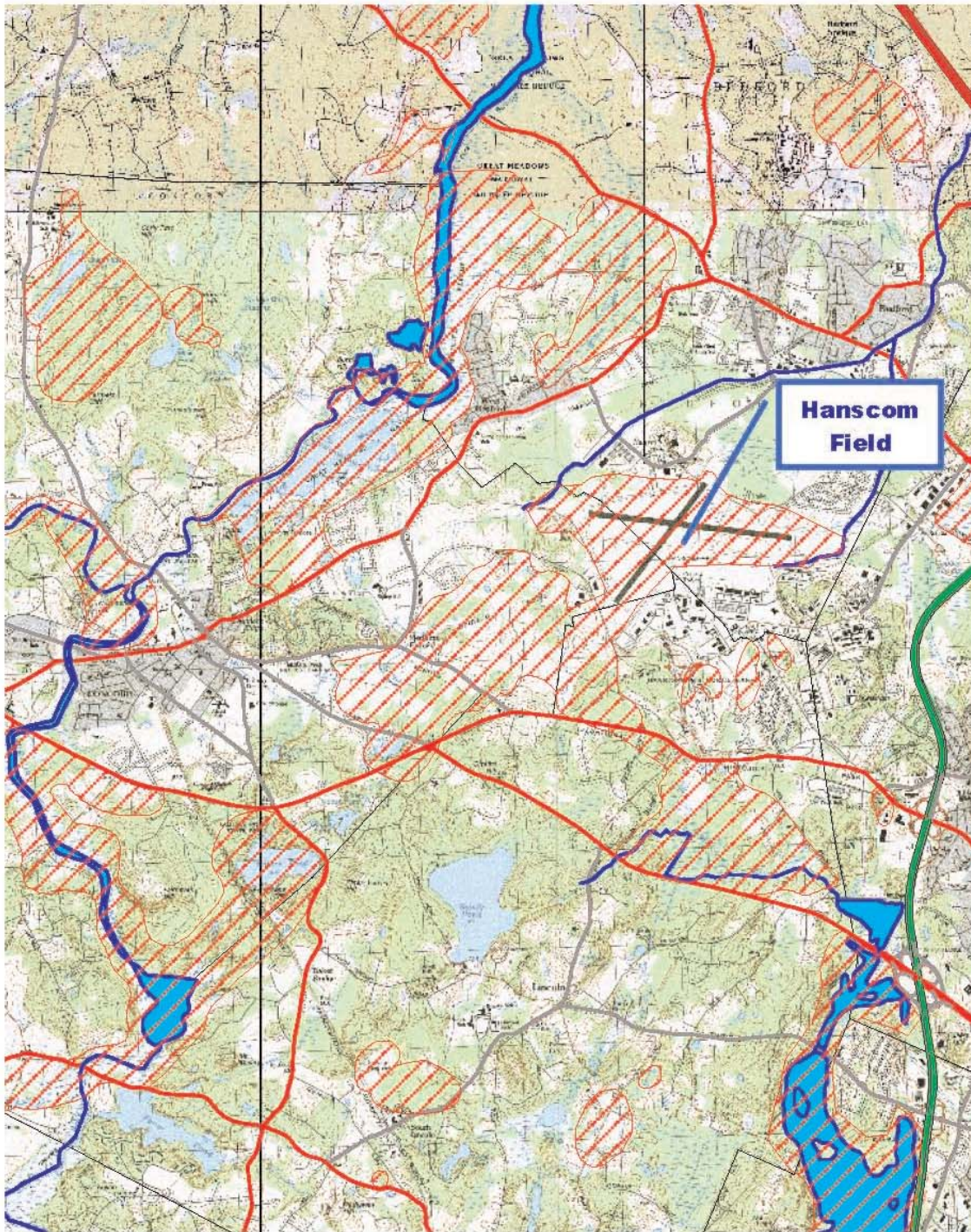
Within the context of MESA, species are listed as endangered, threatened or special concern species. **Endangered** (E) species are "native species which are in danger of extinction throughout all or part of their range, or which are in danger of extirpation from Massachusetts, as documented by biological research and inventory." **Threatened** (T) species are "native species which are likely to become endangered in the foreseeable future, or which are declining or rare as determined by biological research and inventory." **Special Concern** (SC) species are "native species which have been documented by biological research or inventory to have suffered a decline that could threaten the species if allowed to continue unchecked, or which occur in such small numbers or with such restricted distribution or specialized habitat requirements that they could easily become threatened within Massachusetts."

As stated above, Hanscom Field has been documented to support grasshopper sparrow (T) (*Ammodramus savannarum*) and the upland sandpiper (E) (*Bartramia longicauda*). No avian species of special concern (SC) are reported to exist at Hanscom Field.

In 1996, a series of grassland management recommendations were implemented at Hanscom Field together with a limited haying operation. While the management strategies were noted to result in an increase in grassland birds, the program was suspended in 1999 due to a dramatic increase in bird strikes (notably barn swallows) at Hanscom.

Recently, in addition to requirements pursuant to MESA, there has been ongoing interest by the Conservation Commissions of the Hanscom Area Towns, through the recent 2002 – 2006 Vegetation Management Plan (VMP) process, to establish a more formalized *Grassland Management Program* for Hanscom Field.

The grassland management recommendations described herein have been developed with consideration of the Federal Aviation Administration (FAA) Advisory Circular 150/5200-33, *Hazardous Wildlife Attractants on or near Airports*, which states that "**caution should be exercised to ensure that land use practices on or near airports do not enhance the attractiveness of the area to hazardous wildlife.**"



Grassland Management Plan - Hanscom Field
NHESP Priority Habitats (PH) of Rare Species

Figure 2

Source: NHESP Heritage Atlas (11th Edition, July 2003)

Grassland Management Program Goals and Objectives

The goal of this program is to provide safe operating conditions at Hanscom Field and the conservation of listed grassland bird species. In this manner, the grassland management program strives to maintain appropriate habitat that is adequately and safely separated from airport operations. Field evidence suggests that properly managed grasslands can, in fact, reduce bird hazards at airports. According to MA Audubon guidance found at

http://www.massaudubon.org/Birds_&_Beyond/Grassland_Birds/large.html#burning:

"Mowing is essential in grasslands surrounding airfields to prevent growth of woody vegetation and comply with airport safety regulations. However, mowing can be manipulated to reduce mowing costs and benefit grassland birds. Ground-nesting birds found nesting at airfields should not pose a threat to aircraft because of their small size and low direct flight; in addition, managing for these species by leaving some areas unmowed during the summer can help discourage large flocking birds that prefer fields of very short grass, such as gulls, crows, and Canada geese, and are more likely to damage aircraft."

Based upon information developed for the Hanscom Field Vegetation Management Plan 2002-2006, resources available through NHESP, MA Audubon and other sources, a set of grassland management techniques have been developed for Hanscom Field, with the specific goal of managing grasslands at Hanscom primarily for Grasshopper sparrows and upland sandpiper as well as other declining grassland bird species.

It is anticipated that the recommendations included herein will be used as **guidelines** for grassland management at Hanscom Field. The plan has been developed to be flexible enough to allow for the proper management of target hazardous wildlife species without compromising aviation safety. Particular attention will also be paid to the effect that higher grass heights could have on attracting other hazardous wildlife species such as deer, turkey, pheasant, swallows (flocks), raptors, coyote, and fox.

If after implementation of these recommendations there is a documented increase in hazardous wildlife, bird strikes or other safety issues, the plan will be **immediately** modified. However, NHESP will be notified of any modification of this plan and the process will involve timely notification of the Hanscom town conservation commissions.

Draft Grassland Management Recommendations

The following section outlines a series of grassland management guidelines for implementation at L.G. Hanscom Field (BED) in the towns of Bedford, Concord and Lincoln, MA [*Note: there are no grassland areas at BED within the Town of Lexington*]. The management of grassland areas on the airport property will be conducted where such management is compatible with airport operations, and does not result in the attraction of wildlife species that are known to be aviation hazards. While the focus of this plan is the careful management of grasslands in close

proximity to airport operating surfaces, the guidelines are also intended to cover selected airport grasslands outside of the fenced airfield areas. Figure 3 illustrates the general limits of grassland management areas.

These guidelines will be followed until such time that conditions change at BED or there are indications of increased bird strike hazards or other potential compromises to aviation safety. In the event field conditions necessitate revision of the plan, modification will be implemented *immediately* to reduce the aviation safety risk. Changes to the plan will be forwarded to the MA Natural Heritage and Endangered Species Program (NHESP) and the Hanscom town conservation commissions.

1. **Conduct annual pre-breeding season review of grassland management procedures and protected grassland birds identification** (upland sandpiper and grasshopper sparrow) **with operations staff.**
2. **Develop an annual mowing schedule** that would maintain managed grassland areas at a height of 6-15 inches.
3. **Develop a plan of the managed areas** The plan shall clearly designate managed areas. Where feasible, the areas shall be separated on the plan using existing, observable features in the field such as signage, hangars, pavement intersections, etc. By using such identifiers on the plan, mowing personnel can more easily identify the different mowing areas in the field. Mowing areas may be adjusted annually based on weather conditions.
4. **Mow Runway and Taxiway Safety Areas prior to May 1**, when feasible, to avoid conflicts with breeding. *[Runway and Taxiway Safety Areas are rectangular areas centered on the runway or taxiway centerlines that include both the runway/taxiway and shoulders. These safety areas are typically level turfing areas that are capable of supporting maintenance and rescue equipment and the occasional passage of an aircraft without causing major damage to the aircraft.]*
5. **Maintain mowed strips along runways (250-feet from runway centerlines) and taxiways (85-feet from taxiway centerlines)** throughout the breeding season to discourage birds from nesting in these areas. Maintenance of the safety areas to the ground elevation is necessary throughout the year to comply with FAA Part 139 certification criteria. The safety areas include all areas immediately adjacent to paved surfaces. Where these adjacent areas are less than 50 feet in width, they will not be included in this management program.

Most grassland birds prefer the presence of a range of grass heights within the habitat area. By mowing the airport safety areas throughout the growing season, nesting is discouraged. A spring season mowing of these areas prior to nest building activities will discourage nesting in safety areas. By completing an early season mowing, the breeding pairs will opt for the adjacent undisturbed habitat management areas, thus confining the nesting away from the airport operations.

Figure 3 Hanscom Field Grassland Management Program Areas

(11x17 COLOR MAP INSERT OF MOWING AREAS)

6. **Restrict mowing during the breeding (nesting and brood-rearing) season.** (May 1 to July 31) on designated portions of airfield not directly adjacent to runways and taxiways. (Figure 3). Late July typically represents the end of the brood season for most grassland birds, including those species which commonly produce a second brood such as grasshopper sparrow.
7. **Conduct pre-mowing field reconnaissance to observe and mark locations of nesting birds** in "critical areas" [see safety area recommendation #4] along runways and taxiways. Mark and maintain 50-foot diameter unmowed buffer around identified nesting areas until birds have fledged. Avoid mowing marked areas until birds have fledged.
8. **Inspect grassland management areas for young prior to mowing.** The August 1st date is to be used as a guide for the onset of mowing of the protected areas. A general inspection of the management unit should be completed by Massport Operations staff to inspect for active nests. Outside agencies such as USDA and or MA Audubon may also be invited to participate in these activities. In the event active nests are identified at this time, mark and maintain 50-foot diameter unmowed buffer around identified nesting areas until birds have fledged. Avoid mowing marked areas until birds have fledged. A reinspection scheduled shall be developed to determine when mowing can resume.
9. **Avoid, as practical, activities on grassland portions of airfield and approach areas** not directly adjacent to runways and taxiways during the breeding season (May 1 to July 31). This would include activities such as parking.

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LAURENCE G. HANSCOM FIELD

2009-2013 VEGETATION MANAGEMENT PLAN

November 2008 Update



Stantec



L.G. HANSCOM FIELD - VEGETATION MANAGEMENT PLAN

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PREFACE

This document is an update to the Vegetation Management Plan for L.G. Hanscom Field. A vegetation management plan (VMP) provides a strategy to be employed by airport operators for prioritizing removal of vegetation which currently penetrates protection zones, and for preventing other vegetation from penetrating protection zones in the future so as to avoid repetitive, large –scale removal projects. Vegetation removal in wetlands at public use airports is regulated by the Massachusetts Wetlands Protection Act (310 CMR 10.00). Within these regulations are provisions for several types of “limited projects,” one of which is specifically for the purpose of removing vegetation penetrations from protected airspace (310 CMR 10.24(7)(c)(5) and 10.53(3)(n)). These limited project provisions were enacted as part of the Wetlands Protection Act in January 1994, with the latest revision effective October 6, 1997. A guidance document for conservation commissions relative to VMPs and the Massachusetts Wetlands Protection Act was prepared by the Massachusetts Aeronautics Commission, Massport, the Federal Aviation Administration and the Department of Environmental Protection in 2004. This document, entitled “Vegetation Management at Airports; a Guidance Document to Conservation Commissions” contains important information on the purpose and need for VMPs, the selection of removal and maintenance methods, effects of removal on wetland functions and values, and a discussion of VMPs relative to the Massachusetts Wetlands Protection Act Regulations. It is available at <http://www.massaeronautics.org/downloads/macfiles/AirportVMPConsCommGuidanceDoc03-24-04.pdf>.

The limited project provisions were the result of a Generic Environmental Impact Report (EOEA No. 8978) produced by the Massachusetts Aeronautics Commission (MAC) and the Massachusetts Port Authority (Massport) which was finalized on August 31, 1993. The Certificate for this GEIR was issued on October 15, 1993. As a follow-up to the GEIR and the limited project provisions, the MAC, Massport and the Massachusetts Department of Environmental Protection (DEP) prepared and submitted an update to the 1993 GEIR in November 1999 titled “*GEIR Update/Expanded GENF - Airport Vegetation Management*.” This GENF (Generic Environmental Notification Form) was a requirement of the 1993 Certificate and served as a progress report on vegetation management projects sponsored by the MAC and Massport that had occurred in Massachusetts to date. A second GEIR Update and Expanded GENF was prepared by MAC and Massport in June 2006 providing another progress report on the statewide VMP process.

The existing limited project provisions of the Massachusetts Wetlands Protection Act require that Notices of Intent filed for vegetation removal projects at public use airports include a five-year vegetation management plan (VMP) with the following elements:

- a. purpose and goals statement,
- b. identification of airport protective zones,
- c. identification of proposed vegetation management areas within the protective zones,
- d. identification and prioritization of future vegetation removal projects.

Based on recommendations from the 1993 GEIR and the 1999 and 2006 GENFs, vegetation management plans, or VMPs, have been increasingly expanded to include comprehensive background information that is collected and analyzed during their development. In addition,

an open, public planning process was added to the VMP development, which is conducted prior to the submission of a Notice of Intent for a specific vegetation removal project identified in the VMP. This open, public planning process uses several forums for notification, disseminating information, and for receiving input from the general public and from other interested agencies.

L.G. Hanscom Field (Hanscom) is owned and operated by the Massachusetts Port Authority (Massport). Penetrations to Federal Aviation Administration (FAA) protected airspace exist at Hanscom. This VMP serves as a guide to effectively and responsibly manage their removal and to deter the development of new obstructions while protecting the environment. The VMP will allow Massport to comply with FAA airspace regulations, orders and advisory circulars regarding navigational aids, approach light systems and published approach procedures at Hanscom in accordance with the Wetlands Protection Act. The Limited Project provisions state that airport vegetation removal projects "shall not include the construction of new airport facilities or the expansion or relocation of existing airport uses." This vegetation management plan totally complies with this stipulation. The VMP, all associated permitting (through the Notice of Intent process) and vegetation removal and management will not alter the current permitted operation of the airport or enable larger or louder or more aircraft to use the airport.

It is important to understand that the VMP does not serve as a permit to remove vegetation from wetlands. It is a guidance and strategy document that includes all vegetated areas in and around the airport that may be subject to any vegetation management in relation to protected airspace. It is a comprehensive document to be used by the owners of an airport, the sponsors of any vegetation removal project, and those involved with preparing and effecting any vegetation removal at the airport, whether in uplands or wetlands. It is also an important element of the Notice of Intent when a specific project moves to the permitting phase for work in wetlands. Where this VMP provides general management techniques for various vegetated areas of the airport, the Notice of Intent for a specific removal project will address the more detailed information necessary regarding removal techniques and site access restrictions.

In accordance with the Massachusetts Wetlands Protection Act, this VMP provides guidance for a five-year period. As it is updated, the document will continue to include the subsequent five-year period and builds upon information learned and from proven successes from the previous period. A committed maintenance program is part of this five-year plan. The evolution of the VMP is to be based on results of vegetation removal and management efforts, findings of monitoring efforts, changes in available management techniques, changes in site conditions, changes in environmental regulations and practices, and renewed obstruction analysis.

CHAPTER 1: INTRODUCTION

In 2002, Massport prepared a Vegetation Management Plan (VMP) to guide the maintenance of protected airspace at L.G. Hanscom Field. The VMP served as a guide for current and future vegetation removal projects conducted at the airport. This overall guidance document provides necessary background information for each permitting and maintenance cycle that will occur on an approximately 5-year basis as updates to the airspace analysis and project environmental permitting are completed. Upon completion of each cycle, this VMP will be updated to reflect changes in site conditions, lessons learned from previous removal projects, and changes in regulations. The majority of the VMP information will remain per the original document.

This revision is the 2008 Update of the Vegetation Management Plan for L.G. Hanscom Field. It is the first update to the original VMP completed in 2002 and reflects information obtained and lessons learned as a result of the initial removal project and associated maintenance program implemented from 2003 through 2007. Updates are made to the VMP when each new five-year plan is developed. Massport will provide copies of the updated document to the four abutting towns' conservation commissions as part of the permitting process. The Conservation Commission meetings will provide opportunities for the public to review the revisions and ask questions of Massport officials.

A. Purpose and Goals

The purpose of the VMP for L. G. Hanscom Field is to comply with FAA regulations and Massachusetts General Laws regarding protected airspace. Specifically, vegetation removal and management must be undertaken to comply with the following:

Federal Aviation Regulations (FAR) Part 77, *Objects Affecting Navigable Airspace*;
FAA Advisory Circular 150/5300-13, *Airport Design*;
FAA Order 6750.16B, *Siting Criteria for Instrument Landing Systems*;
FAA Order 8260.3B, *United States Standards for Terminal Instrument Procedures (TERPS)*.

In addition to the above-referenced standards, the following standards were reviewed with respect to protected airspace:

1. FAA Order 6850.2A, Chapter 2, regarding approach lighting clearance criteria;
2. FAA Order 6850.2A, Chapter 3, regarding Visual Approach Slope Indicator criteria;
3. FAA Advisory Circular 50/5345-28D, Precision Approach Path Indicator criteria.

These standards are for systems ancillary to instrument landing systems covered under FAA Order 6750.16B.

The goal of the 2008 Update to the VMP for L. G. Hanscom Field is to maintain airport safety in accordance with FAA requirements through the removal of vegetation that currently penetrates or is expected to penetrate protected airspace in and around the airport, and to create low-growing vegetative communities within critical areas to facilitate long-term management of the areas. A secondary goal is to minimize the extent and magnitude of future removal projects. To that end, this VMP will serve as a guide for vegetation removal and management practices that

will minimize the potential for adverse impacts to the environment. It also provides suggestions to adequately mitigate for such impacts. While the VMP is a guide for the current and future vegetation removal projects at the airport, individual permit applications under the Massachusetts Wetlands Protection Act may need to be prepared for specific removal projects. Details regarding wetland impacts, project access routes, staging areas, etc., will be described in the permit applications for each project.

Performed in concert with an obstruction analysis which identified vegetation heights based on aerial photogrammetry, this VMP is the result of a comprehensive and exhaustive environmental review of the entire airfield landscape. The development of a pre-established set of vegetation management techniques tailored to specific areas of the airfield will allow Massport to maintain L.G. Hanscom Field in an efficient and environmentally responsible manner.

B. Setting

Hanscom Field is located in the Towns of Bedford, Concord, Lexington, and Lincoln, Massachusetts (see **U.S.G.S. Site Locus, Figure 1-1**). The facility comprises approximately 1,300 acres of land north of Route 2A and west of Route 128. Topographically, the airport is located within a broad, level plain with intermittent low hills to the south and east. Two perennial stream valleys extend through the property. Elm Brook flows from south to north in the approach to Runway 11, and the Shawsheen River flows from south to north in the approach to Runway 29. Kiln Brook, a perennial tributary to the Shawsheen River, flows from east to west within the approach of Runway 29. Although VMP work will occur within the watershed of this brook; it is not located on airport property.

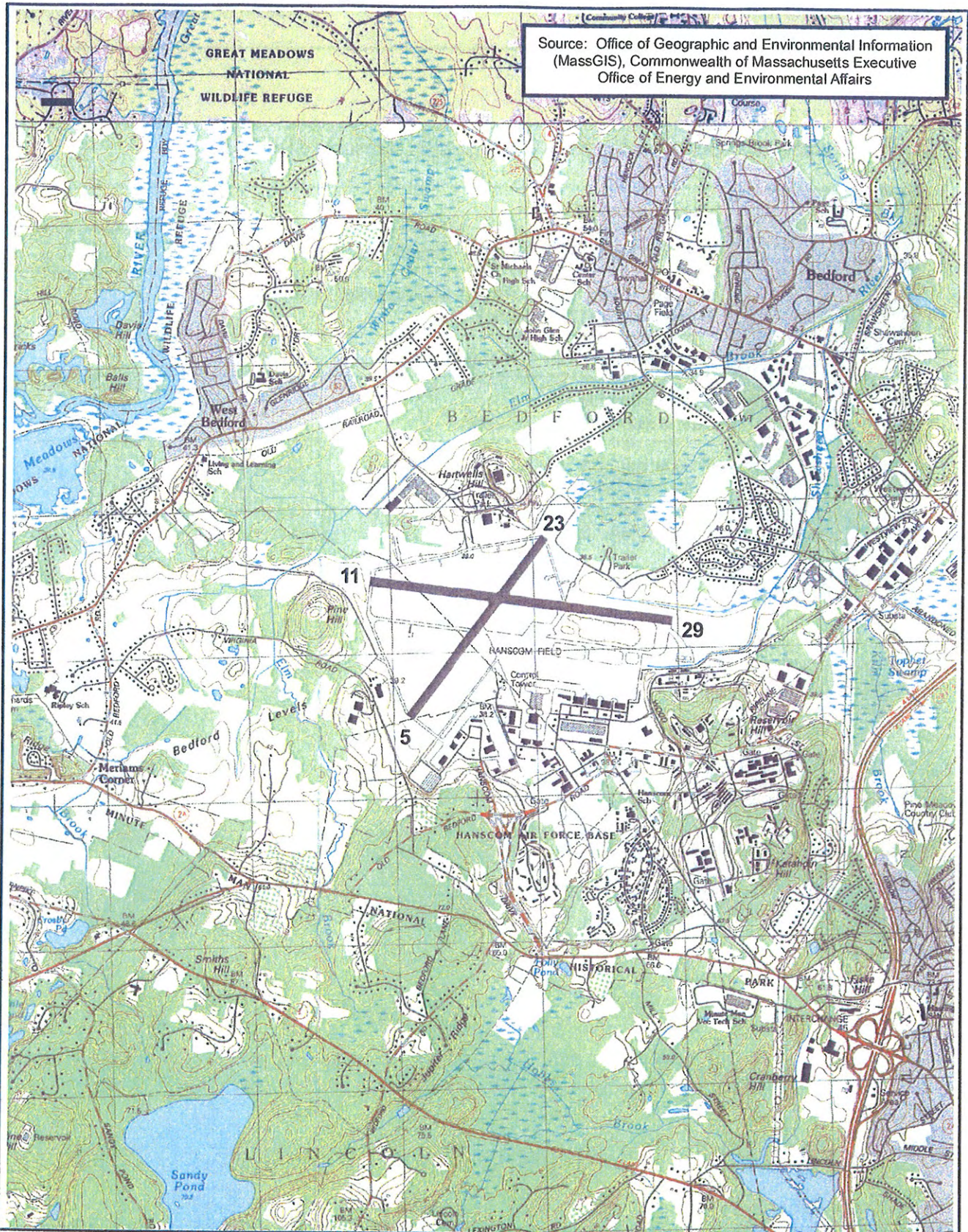
The airport consists of two paved runways. Runway 11-29 is 7,001 feet long and 150 feet wide, and Runway 5-23 is 5,106 feet long and 150 feet wide.

South of the airport, and entirely outside of the VMP project limits, is Minuteman National Historical Park. North of the airport and directly off of the Runway 23 end is the Jordan Conservation Area and the Hartwell Town Forest; two properties owned by the Town of Bedford for conservation and recreation purposes. Airspace management could involve both Bedford properties as discussed in this VMP.

C. General Information

General Information Summary for the 2002-2022 L.G. Hanscom Field VMP:

Airport Name	L.G. Hanscom Field
Airport Location	Bedford, Concord, Lexington, Lincoln - Massachusetts
Contact Person	Mr. Tom Ennis, Senior Project Manager/Senior Planner Telephone: (617) 568-3546
Airport Owner	Massachusetts Port Authority (Massport)
Owner Address	One Harborside Drive East Boston, MA 02128-2909
Airport Director	Ms. Barbara Patzner Massport Civil Air Terminal 200 Hanscom Drive Bedford, MA 01730 Telephone: (781) 869-8000



Source: Office of Geographic and Environmental Information
(MassGIS), Commonwealth of Massachusetts Executive
Office of Energy and Environmental Affairs



L.G. HANSCOM FIELD
VEGETATION MANAGEMENT PLAN
SITE LOCUS
FIGURE 1-1

BEDFORD

MASSACHUSETTS

Project No.	195210330
Proj. Mgr.	SGL
Scale	1" = 3000'
Date	SEPT. 2008

A

CHAPTER 2: AIRPORT PROTECTION ZONES

A. FAA Protected Airspace

The FAA has defined numerous protected airspace “surfaces,” or protection zones, in and around airports. The surfaces important to vegetation management at L. G. Hanscom Field are as follows:

1. *Primary Surface* - a surface longitudinally centered on each runway and extending 200 feet beyond each runway end. For Runway 5-23, this surface is 500 feet wide. For Runway 11-29, which has a precision instrument approach landing system, the primary surface is 1,000 feet wide. The elevation of this surface at any given location is the same as the nearest point on the centerline of the runway. Any object, including vegetation, which is within the primary surface and is at a higher elevation than the runway centerline, is a penetration of navigable airspace.
2. *Approach Surfaces* - sloping areas beginning at the limits of the primary surface at each runway end and extending outward and upward. The surface widens at a prescribed angle as it extends outward. The slope depends on the type of navigation instruments present for each particular runway approach. The approach slopes for Runway 11-29 and Runway 23 are 34:1, meaning the surface rises one foot in elevation for each 34 feet outward from the end of the primary surface. The approach slope for Runway 5 is 20:1. Within the approach surface areas of Runway 11-29 are *approach light planes*, which are 400 feet wide and 2,500 feet long beginning at the runway thresholds. Vegetation within the approach light planes must be maintained below the elevations of the approach lights to ensure that pilots have an unobstructed view of the lights when landing. The slopes of the approach light planes are 50:1.
3. *Transitional Surfaces* - sloping areas extending outward and upward at right angles to the runway centerline and the runway centerline extended at a slope of 7 to 1 from the sides of the primary surface and from the sides of the approach surfaces.
4. *Missed Approach Surface* – sloping areas of varying degree utilized for landing during instrument flight rule (IFR) conditions. If a pilot does not visually locate the landing runway when an established “minimum” elevation and distance from the runway is achieved, the attempted landing must be aborted and a missed approach must be flown.

Figure 2-1 shows the areas of the primary, approach, and transitional surfaces at L.G. Hanscom Field. **Figure 2-2** shows a three-dimensional view of the approach surface and the approach light plane at the Runway 11 end. **Figure 2-3** shows graphics of typical precision missed approach surfaces from FAA Order 8620.3B, *U.S. Standard for Terminal Procedures (TERPS)*. These areas are the basis for the vegetation management areas that have been defined in this VMP. Runway designations and threshold locations have not changed from previous projects, nor will they change as a result of any vegetation management proposed in this VMP.

B. Identification of Airspace Obstructions

Prior to the development of each VMP update, Massport completes an extensive analysis of the existing obstructions at L.G.Hanscom Field using aerial photogrammetry (obtained in 2007) to determine object heights and ground elevations. The photogrammetry data included the elevations of the ground surface, structures, vegetative canopy height, and in sparsely vegetated areas, individual trees. The photogrammetry data is compared to three dimensional computer modeling of the primary, approach, transitional and missed approach surfaces at the airport based upon existing runway lengths, widths, approach categories, and navigational aid types and locations. The model assigns elevations to all of the protected airspace surfaces and compares them to the identified object elevations. Where vegetation is sparse, individual tree heights were identified from the aerial photogrammetry. Where the cover is dense, it is not feasible to determine the height of each stem. In these areas, the tallest point is determined within a 50 foot by 50 foot grid. Field analysis is then used to supplement this data to determine whether an identified penetration represents one or more actual trees, saplings and/or shrubs.

The photogrammetry data used for the VMP update was collected in June 2007. Copies of the VMP update will be provided to the four towns' libraries and conservation commissions.

The comparison of elevations between the protected airspace surfaces and vegetation around L.G. Hanscom Field allows for a determination of the location and extent of penetrations to these surfaces. A two-dimensional point plot of the analysis is prepared to show all points that are currently penetrating the protected airspace as well as those that are within ten feet below each individual surface. (**Figure 2-4** shows an example of a portion of a point plot from the airspace analysis from the 2007 photogrammetry data.) Tables are then generated to describe the type of penetration (i.e. vegetation, pole, building), the elevation of the top of the object in feet above mean sea level, the ground elevation, and the elevation of the object with respect to the protected airspace surface. Woody vegetation within ten feet below protected airspace is expected to become a penetration within five years and so is included in each removal project. After five years, it is recommended that the vegetation management plan be updated with new aerial photogrammetry point data.

Through careful comparison of the penetration data with the various vegetation species and cover types, it is possible to determine the extent of the required vegetation removal. In many areas, only sporadic individual penetrations need removal. In other areas, significant understories may be preserved beneath the taller penetrating vegetation. The relative height of the protected airspace and the ground is important. Where the protected airspace is only a few feet above the ground, for example, removal of woody vegetation to ground level may be necessary, and a management method may then be employed to encourage lower growing vegetation to thrive. Where the airspace elevation is well above the ground, management for a taller vegetative community is possible.

Upon completion of the original (1998) obstruction analysis, the vegetation types and the environmental resources that exist within the study area were identified for the original VMP. For each update, the environmental resources are re-investigated for any potential changes. Sensitive environmental resources within the project area are discussed in Chapter 3.

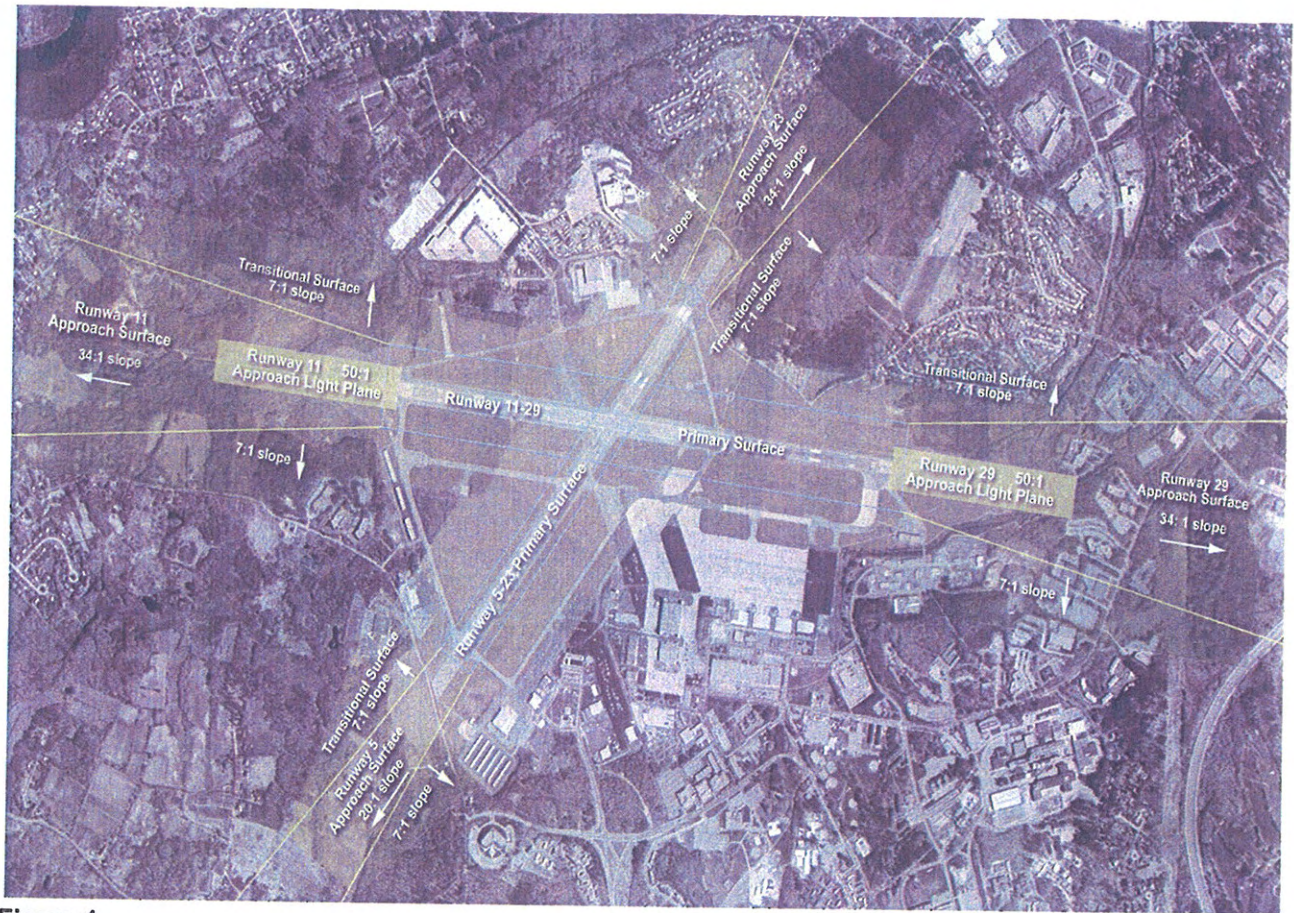


Figure 1

1

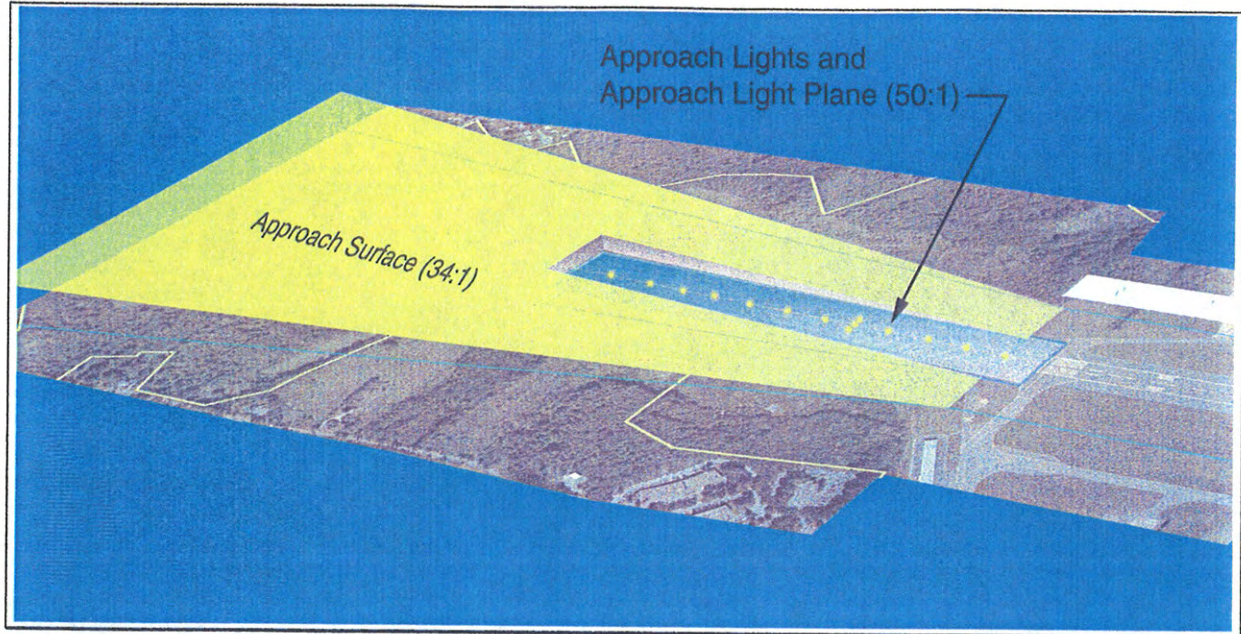


Figure 2

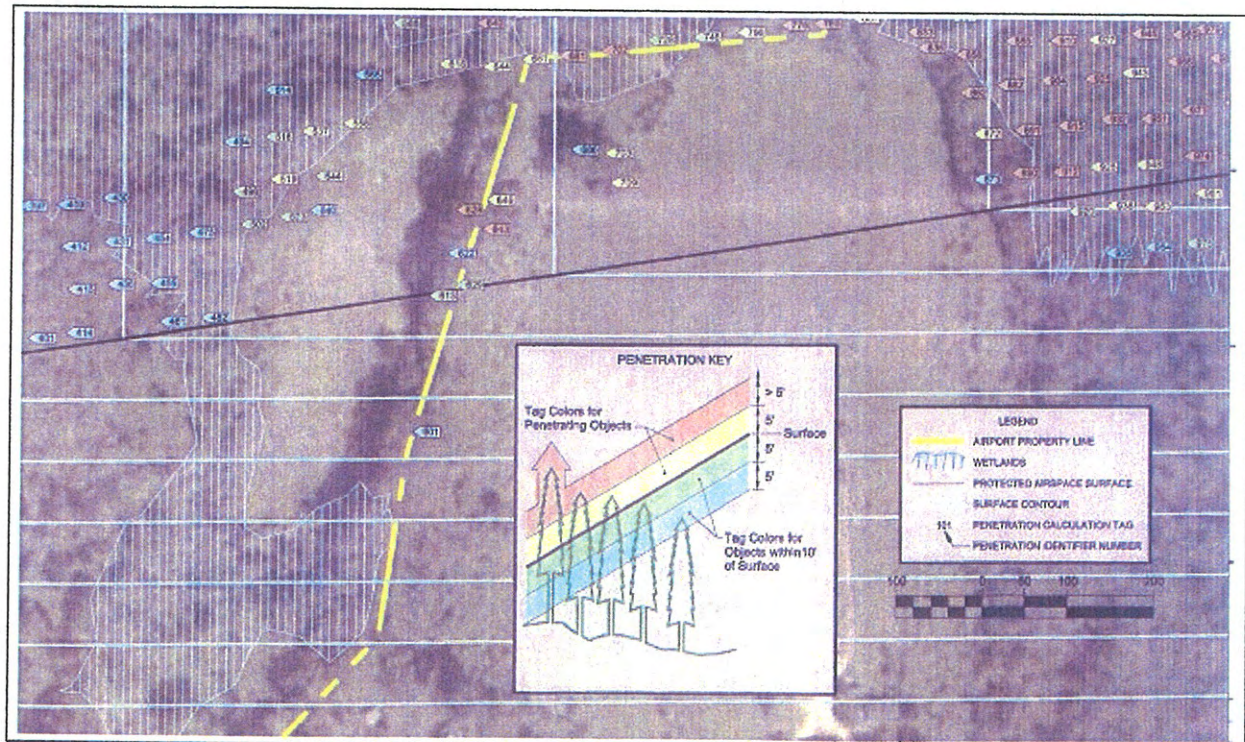


Figure 3

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5/15/02

(3) Compare the ROC surface elevation at the clearance limit with the 40:1 surface elevation.

(a) If the computed 40:1 surface elevation is equal to or greater than the ROC surface elevation, a climb-in-hold evaluation is NOT required.

(b) If the computed 40:1 surface elevation is less than the ROC surface elevation, a climb-in-hold evaluation IS required. FAA Order 7130.3, Holding Pattern Criteria, paragraph 35, specifies higher speed groups and, therefore, larger template sizes are usually necessary for the climb-in-hold evaluation. These templates may require an increase in MHA under TERPS, paragraph 293a. If this evaluation requires an increase in the MHA, evaluate the new altitude using the higher speed group specified in paragraph 35. This sequence of review shall be used until the MHA does not increase, then the 40:1 surface is re-evaluated. If

obstacles penetrate the 40:1 surface, take action to eliminate the penetration.

d. The charted missed approach altitude is the higher of the preliminary charted missed approach altitude or the MHA established under paragraph 274c(3)(b).

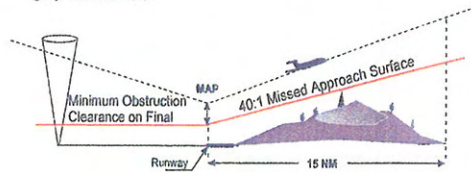


Figure 17. STRAIGHT MISSED APPROACH OBSTACLE CLEARANCE. Par 274.

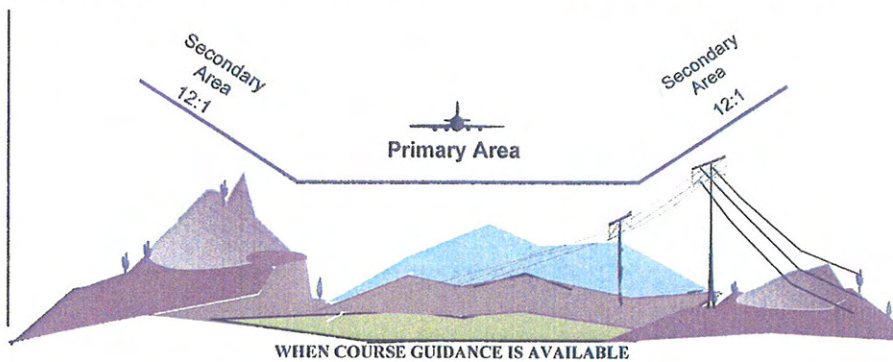


Figure 18. MISSED APPROACH CROSS SECTION. Par 274.

275. TURNING MISSED APPROACH AREA. (See Volume 3 for special provisions). If a turn of more than 15° from the FAC is required, a turning or combination straight and turning missed approach area must be constructed.

NOTE: If the HAT value associated with the DA/MDA is less than 400 feet, construct a combination straight and turning missed approach (see paragraph 277) to accommodate climb to 400 feet above touchdown zone elevation prior to turn.

a. The dimensions and shape of this area are affected by three variables:

- (1) Width of final approach area at the MAP.
- (2) All categories of aircraft authorized to use the procedure.
- (3) Number of degrees of turn required by the procedure.

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CHAPTER 3: SENSITIVE ENVIRONMENTAL RESOURCES

Preparation of this VMP update involved the investigation of various environmental resources which could affect the design of the vegetation management program. Data were collected from state, federal, and municipal agencies as well as from field research. The following is a list of protected environmental resources investigated as part of the preparation of this VMP update.

- Rare and Endangered Species (state and federal)
- State and Federal Wetland Resources
- Areas of Critical Environmental Concern (state-defined)
- Wild and Scenic River Corridors (U.S. Dept. of the Interior)
- Drinking Water Supplies (Massachusetts Water Quality Classification)
- Nuisance Vegetation
- Steep Slopes
- Organic Soils
- Historic/Archaeological Resources
- Closed Landfill Areas

Table 3-1 provides a summary of the results of the environmental resources investigation.

A. Rare and Endangered Species

The most recent edition of the Massachusetts Natural Heritage Atlas (October 1, 2006) was consulted to determine whether this proposed VMP update will adversely impact any state-listed rare or endangered wildlife species. The Atlas indicates the presence of three certified vernal pools within Vegetation Management Area (VMA) 2 at the Runway 11 end in the Town of Concord on the Estimated Habitat Map (**Figure 3-1**). Additionally, a non-certified vernal pool area exists just north of the Runway 29 end within VMA 6 in the Town of Bedford.

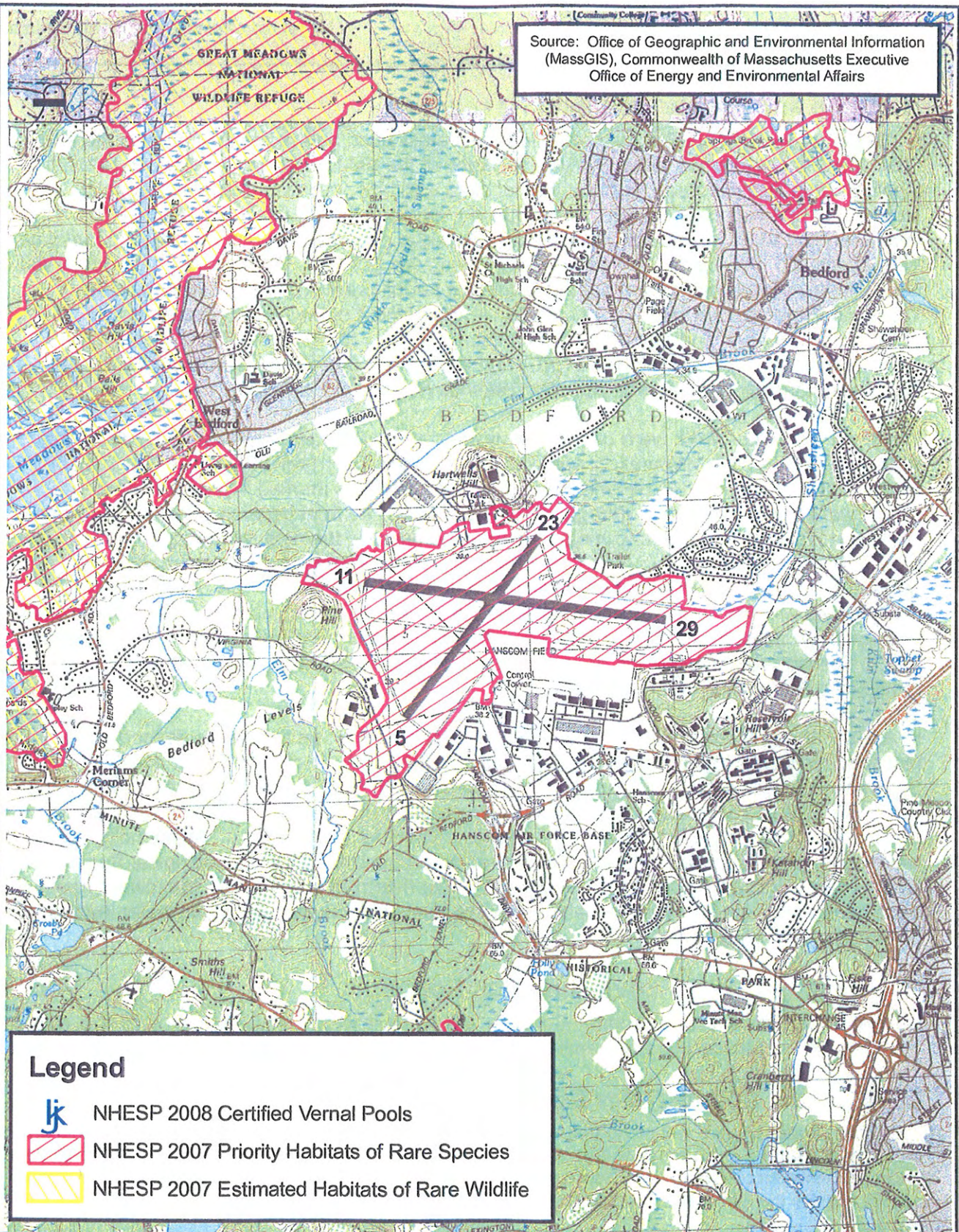
The Atlas also shows a priority site designation (site PH-461 pursuant to the Massachusetts Endangered Species Act) for much of the non-wooded areas within the airport property (**Figure 3-1**). The identified species within the priority site designation include Grasshopper Sparrow (*Ammodramus savannarum*), Upland Sandpiper (*Bartramia longicauda*), and Elderberry Longhorn Beetle (*Desmocerus palliatus*). Due to the presence of protected wildlife species within and adjacent to the proposed clearing areas, coordination with the Massachusetts Natural Heritage and Endangered Species Program (MNHESP) during the preparation of each removal project under this VMP update will be required. Coordination will include the submission of a copy of the Notice of Intent (Massachusetts Wetlands Protection Act) for each removal project to the MNHESP for review and comment. Note that Massport has developed and enacted a grassland bird management plan as a part of the implementation of the original VMP.

Chapter 5 includes project mitigation measures designed to protect, preserve, and, in places, enhance the habitat provided for state-listed rare wildlife species. Vegetation within each of these identified habitat areas will be managed based upon the selected management technique described in Chapter 4 and shown on the VMA Map in Appendix F. However, the management within the identified sensitive habitat will be completed with additional mitigation measures, so that the obstruction is addressed, but the habitat is protected.




Table 3-1: *Summary of the environmental constraints analysis*

Protected Resource	Present or Absent at the airport	Comments
Rare and Endangered Species	Present	State-level threatened and special concern species have been identified within the project limits. Three certified vernal pools exist within the property limits at the RW 11 end (Concord), and one non-certified pool exists at the RW 29 end (Bedford). Notice of Intent review by the Mass. Natural Heritage Program required.
State / Federal Wetlands	Present	Full delineation of wetlands within the VMAs has been completed for this VMP
Areas of Critical Environmental Concern	Absent	No ACECs occur within the project area according to the Department of Conservation and Recreation (formerly Ma. Dept. of Environmental Management).
Wild and Scenic Rivers	Absent	The Shawsheen River and tributaries are not listed as Wild and Scenic by the National Park Service (NPS) according to the most recent update of the NPS database.
Public Water Supplies	Present	Elm Brook at the Runway 11 end and much of the surrounding land is within the Zone II of a public water supply wellfield. The Zone II designation indicates that it is a contributing watershed to the well.
Nuisance Vegetation	Present	European Buckthorn Common Reed and Purple Loosestrife exist within both wetland and upland areas on the project site. Buckthorn is a dominant shrub in most upland and wetland wooded areas of the airport property.
Steep Slopes	Present	Designated access routes and sensitive clearing techniques have been specified for the Shawsheen River and Elm Brook corridors which contain steep bank areas.
Organic Soils	Present	Full delineation of wetlands within the VMAs has been completed for this VMP and areas of soft soils identified.
Historical/Archeological Resources	Present	No reduction in visual buffer between Minuteman National Historical Park and aircraft operating areas will be allowed.
Closed Landfill Areas	Present	No equipment or vehicles will be allowed on or near landfill caps to ensure no damage is done to these areas.

Source: Office of Geographic and Environmental Information
(MassGIS), Commonwealth of Massachusetts Executive
Office of Energy and Environmental Affairs



Legend

-  NHPSP 2008 Certified Vernal Pools
-  NHPSP 2007 Priority Habitats of Rare Species
-  NHPSP 2007 Estimated Habitats of Rare Wildlife



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L.G. HANSCOM FIELD VEGETATION MANAGEMENT PLAN ESTIMATED AND PRIORITY HABITATS FIGURE 3-1

BEDFORD

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Project No.	195210330
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Scale	1" = 3000'
Date	SEPT. 2008

A

B. State and Federal Wetland Resources

Implementation of the VMP update requires the identification and delineation of the state and federal wetland resources within the VMAs. Many of the VMAs contain penetrations that are located within wetland areas, buffer zones of state wetlands, riverfront areas of perennial streams, or 100-year flood zones. Consequently, environmental permits are required to implement the VMP. If soil alteration within wetlands is proposed, a permit is required pursuant to Sections 401 and 404 of the Federal Clean Water Act (33 USC 1251 et seq.). Any proposed work within wetlands or wetland buffers requires a permit pursuant to the Massachusetts Wetlands Protection Act (MGL c. 131 s. 40). A requirement of the permit process is the delineation of the wetland resource areas pursuant to the *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* (1987) and the manual *Delineating Bordering Vegetated Wetlands* pursuant to the *Massachusetts Wetlands Protection Act* (1995).

Wetlands within the VMAs were delineated by certified professional wetland scientists for this VMP update. The field delineation was completed during the growing season, in August 2001 and updated in July 2008. The limit of vegetated wetland was marked in the field using sequentially numbered surveyor flagging (pink and blue) tied to vegetation. These flags were refreshed for the 2008 update within those areas pertinent to the next removal project. To provide for quick identification of the wetland flags, each delineation point was marked with "witness" flags tied above and below the numbered flag to provide for easy observation in the field. These wetland areas were approved by the conservation commission of each municipality through the Abbreviated Notice of Resource Area Delineation (ANRAD) process in December 2001. The limits of the wetlands are shown on the Vegetation Management Areas map provided in Appendix F of this VMP.

In addition to vegetated wetland, other wetland resources exist on the site as defined in the Massachusetts Wetlands Protection Act Regulations (MWPA). Both Elm Brook and the Shawsheen River contain 100-year floodplain identified by the Federal Emergency Management Agency (FEMA). These areas are shown in **Figures 3-2 through 3-4**. A floodplain is a resource area known as "bordering land subject to flooding" in the MWPA. Additionally, these waterways are both shown to be perennial streams on the United States Geological Survey Quadrangle (**Figure 1-1**) and thus contain a 200-foot riverfront area measured outward from each bank. Additionally, the area between the banks below the average mean water level is defined as "land under water".

C. Areas of Critical Environmental Concern

No Areas of Critical Environmental Concern are located within close proximity to the airport according to the Massachusetts Department of Conservation and Recreation Website, 2008.

D. Wild and Scenic River Corridors

The United States Department of the Interior National Park Service maintains a database on the wild and scenic river program which provides the regulatory status of all rivers which have been designated since the implementation of the Wild and Scenic Rivers Act. The Shawsheen River, Elm Brook, and Kiln Brook are not listed in the most recent update (2006) of the database.

E. Drinking Water Resources / Outstanding Resource Waters

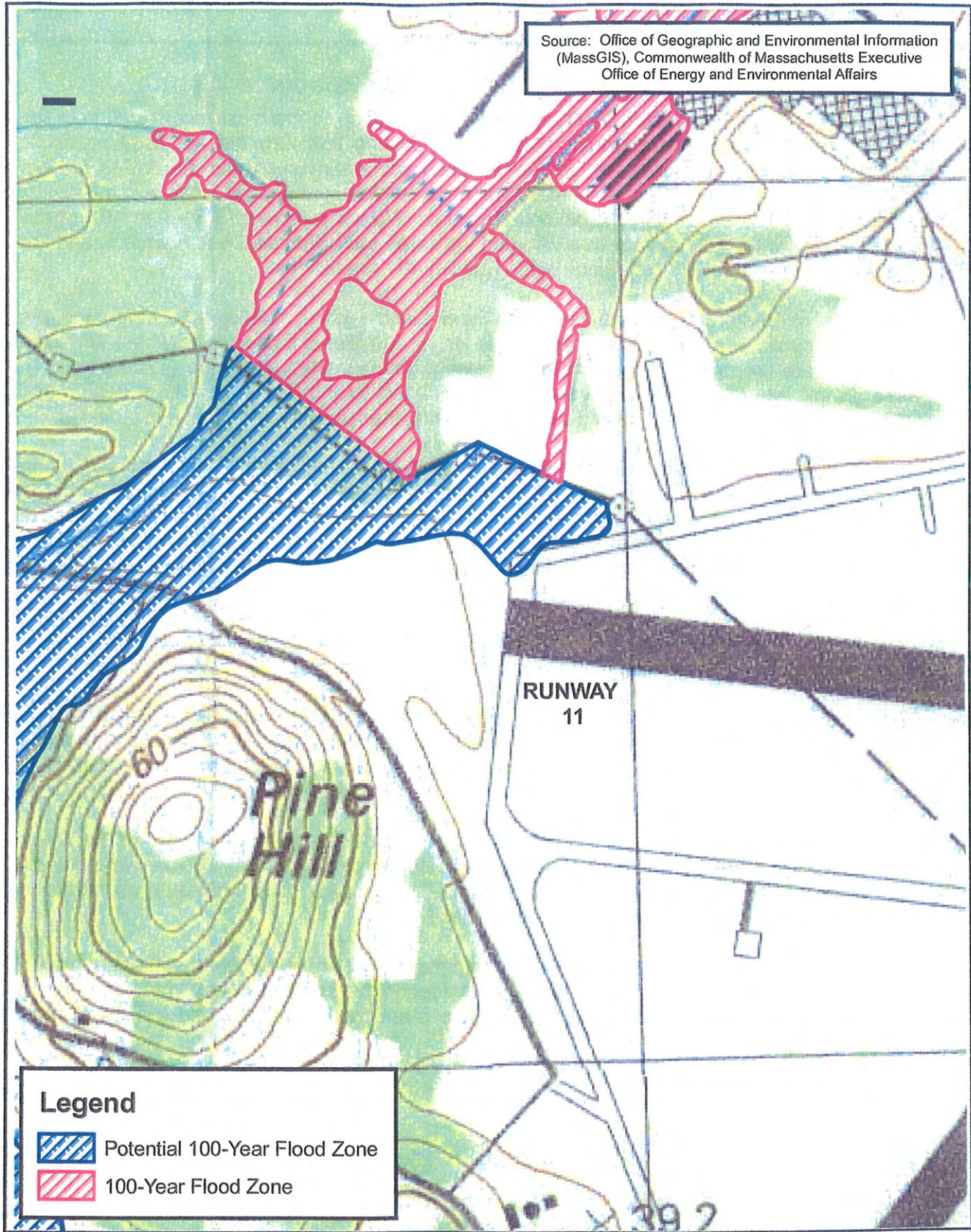
The on-site waterways are listed as Class B waters according to the most recent edition of the Massachusetts Surface Water Quality Standards indicating that they are not used as public drinking surface water supplies. While the wetlands and waterways within the VMAs are not considered to be drinking water resources, the three certified vernal pool areas at the Runway 11 end are considered to be Outstanding Resource Waters pursuant to Section 401 of the Federal Clean Water Act, and are thus afforded the same protection as Class A waters, and are subject to the "no alteration" provisions of the Section 401 regulations.

The Towns of Bedford, Concord, Lexington, and Lincoln were consulted to determine the presence of public or private water supply wells within 400 feet of those VMAs where herbicide applications are proposed as a secondary vegetation management technique (see Chapter 4). Based on the lists of registered private wells maintained by the towns' boards of health, and discussions with the individual town water departments, the following information is provided:



- The Town of Bedford maintains only three public water supply wells located along Shawsheen Road near the Page Road intersection. The proposed herbicide applications are located outside of the Zone I and Zone II boundaries of this wellfield. The remaining Town water is provided by the Massachusetts Water Resources Authority (MWRA). No private potable water supply wells were identified within the Town of Bedford adjacent to the site.
- A Zone II delineation of a public water supply wellfield includes a portion of the airport property along Elm Brook at the Runway 11 end (figure 3-5).
- The Town of Lexington obtains municipal water exclusively from the MWRA, and does not maintain any active municipal wells adjacent to the airport. The business park at the Runway 29 end is serviced by municipal water and does not maintain an on-site potable water supply well.
- The Town of Lincoln municipal water supply is located in the southern end of the Town. The Zone I and Zone II boundaries do not extend into any VMAs. Private water supply wells exist within Lincoln along Airport and Old Bedford Roads, however no herbicide applications will occur within 400 feet of these areas.

Based on the investigation of water supplies within the project area, the use of state-approved herbicide applications as a secondary management technique in the identified VMAs is allowable under the present drinking water regulations and the Massachusetts Pesticide Control Act.

Source: Office of Geographic and Environmental Information
(MassGIS), Commonwealth of Massachusetts Executive
Office of Energy and Environmental Affairs



Legend

-  Potential 100-Year Flood Zone
-  100-Year Flood Zone



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L.G. HANSCOM FIELD VEGETATION MANAGEMENT PLAN FEMA FLOOD MAP - RUNWAY 11

FIGURE 3-2

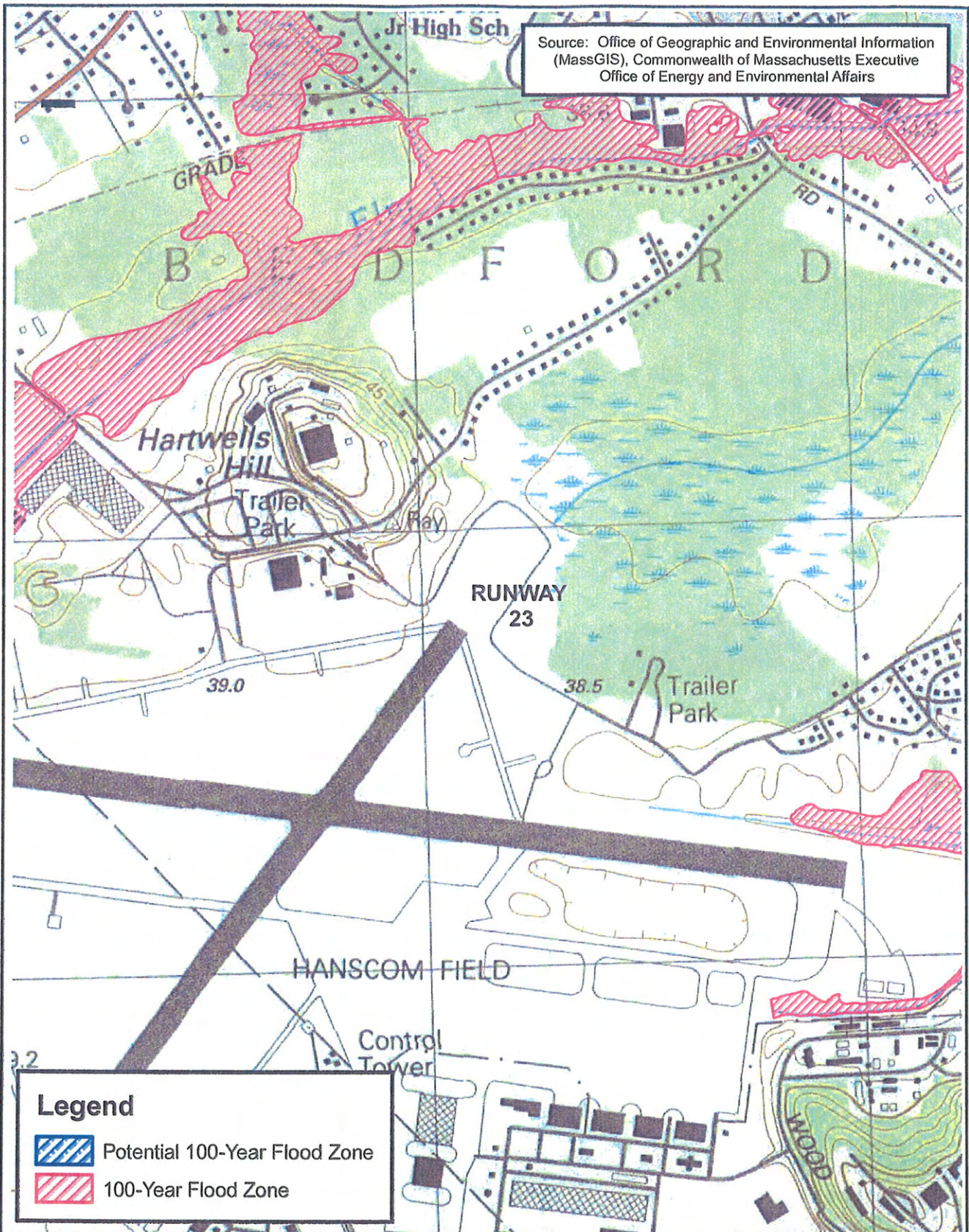
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A

Source: Office of Geographic and Environmental Information
(MassGIS), Commonwealth of Massachusetts Executive
Office of Energy and Environmental Affairs



Legend

-  Potential 100-Year Flood Zone
-  100-Year Flood Zone



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L.G. HANSCOM FIELD VEGETATION MANAGEMENT PLAN FEMA FLOOD MAP - RUNWAY 23 FIGURE 3-3

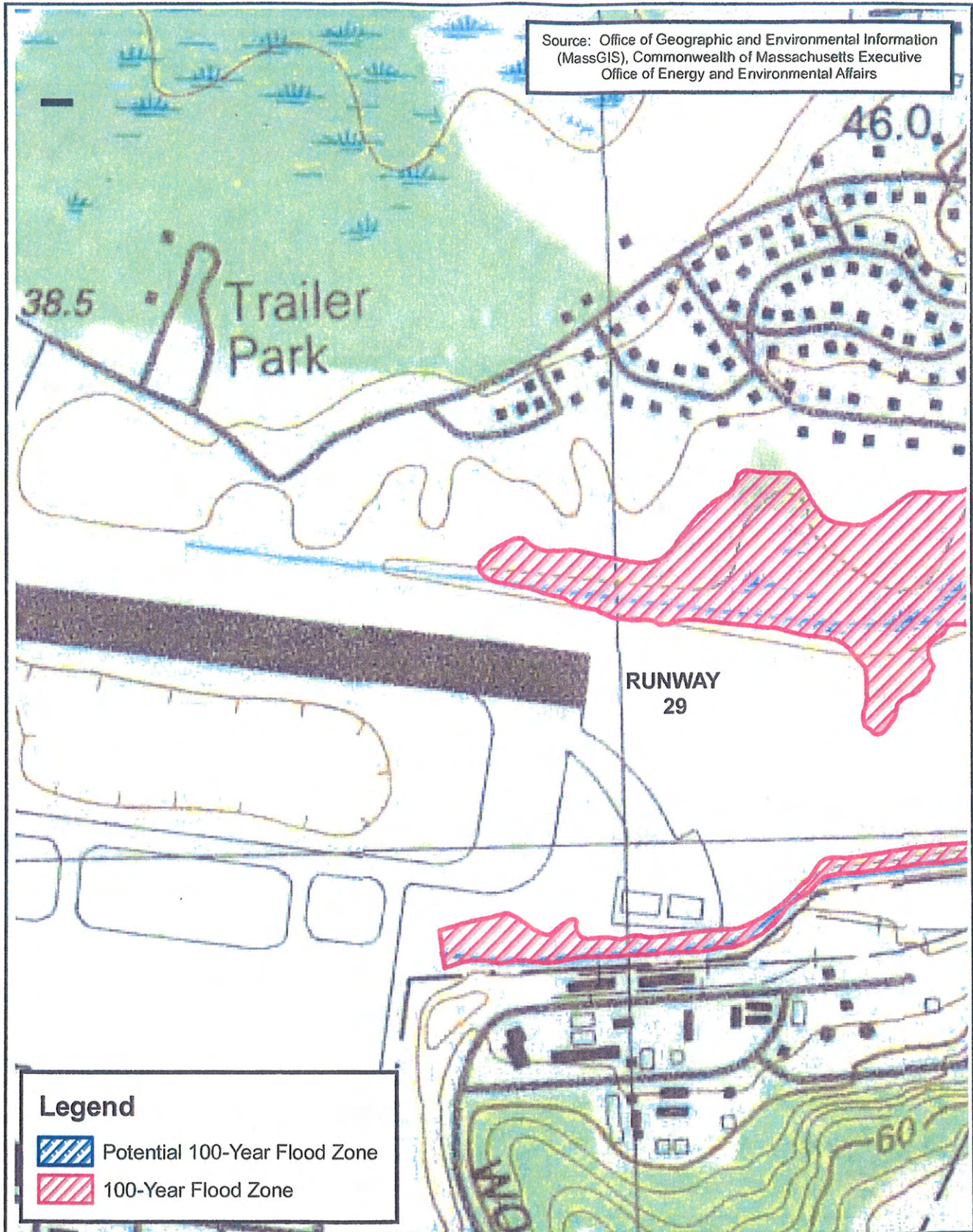
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Project No.	195210330
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Source: Office of Geographic and Environmental Information
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Office of Energy and Environmental Affairs



Legend

-  Potential 100-Year Flood Zone
-  100-Year Flood Zone



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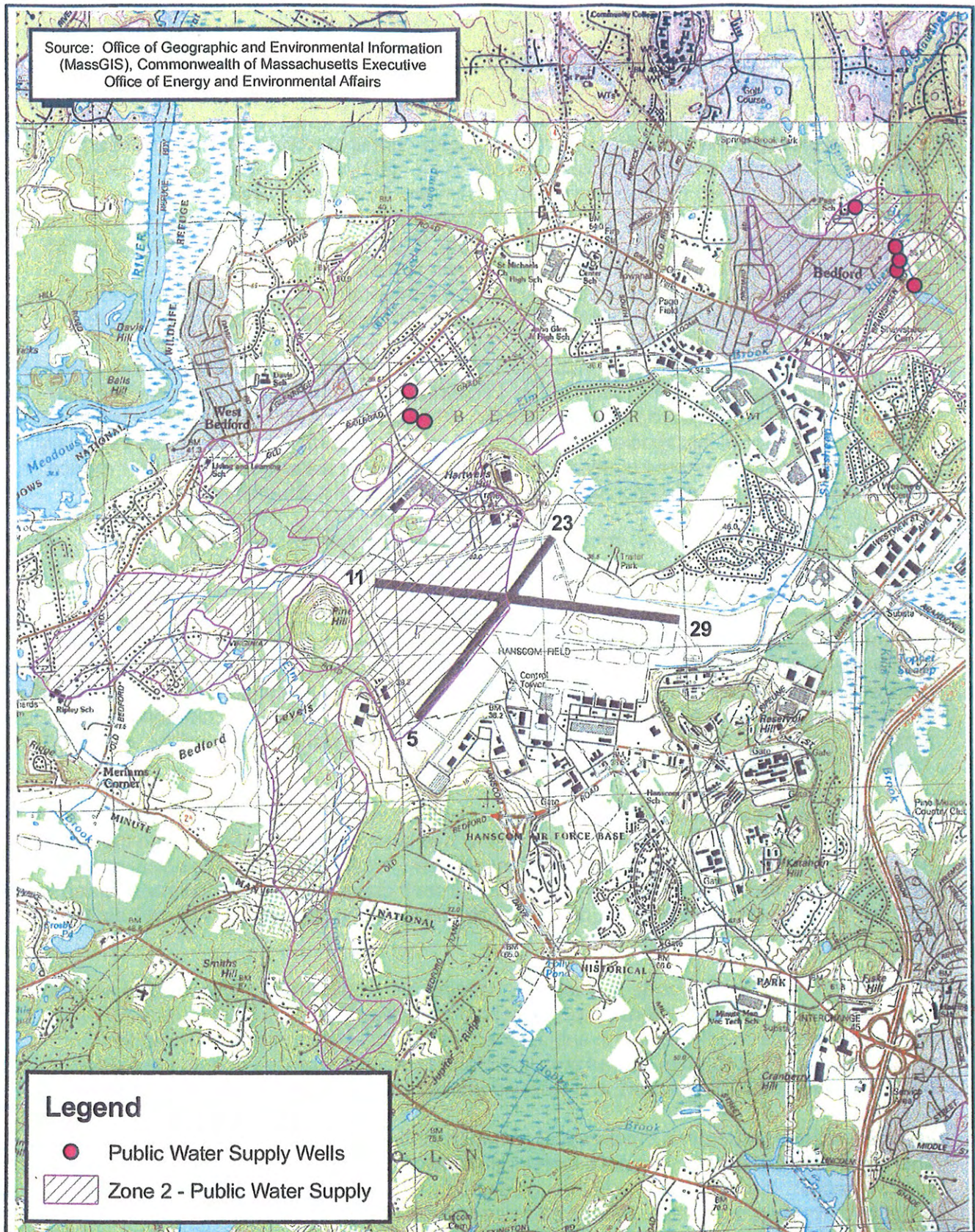
L.G. HANSCOM FIELD
VEGETATION MANAGEMENT PLAN
FEMA FLOOD MAP - RUNWAY 29
FIGURE 3-4

MASSACHUSETTS

Project No.	195210330
Proj. Mgr.	SGL
Scale	1" = 500'
Date	SEPT. 2008

A

Source: Office of Geographic and Environmental Information
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Office of Energy and Environmental Affairs



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L.G. HANSCOM FIELD
VEGETATION MANAGEMENT PLAN
WATER RESOURCES MAP
FIGURE 3-5

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Project No.	195210330
Proj. Mgr.	SGL
Scale	1" = 3000'
Date	SEPT. 2008

A

F. Nuisance Vegetation

The airport property and adjacent properties presently contains established stands of purple loosestrife (*Lythrum salicaria*). Purple loosestrife is an herbaceous species which is capable of rapid colonization of disturbed soils and can outcompete most native vegetation where disturbed soils and full sun coverage occur within and adjacent to wetland areas. This species is dominant within the emergent marsh area of VMA 13, but is also common within the beaver impact areas of the Elm Brook and Shawsheen River corridors at the Runway 11, 29, and 23 ends. Where seed stock for these species exists, it is imperative that disturbed soil surfaces be protected within both upland and wetland areas, and that native vegetation is established through seeding where soil alterations occur. The spread of this species is primarily a concern in those wetland areas where conversion from a scrub-shrub wetland to a wet meadow area will result from the vegetation removal (VMA 7). In these cases, immediate protection of the soil through seeding is required to block colonization. Selective removal and mowing frequencies can be used to control this species within the VMA in the long term. Mowing can be especially effective if it is completed prior to seed germination. Mitigation measures to control or reduce the spread of nuisance vegetation on the airport are discussed in Chapter 5.

European buckthorn (*Rhamnus frangula*), an invasive shrub species also located on the property, is the dominant shrub layer species in most wooded wetland areas on the site (see Appendix A). It is immune to removal through cutting, and is capable of rapid colonization of areas where competition is low, and light penetration is not a limiting factor. Seed dispersal by this species is completed by several common wildlife species, thus eradication of buckthorn from a site is not feasible if seed stock occurs within adjacent, unmanaged areas. The proposed control of this species within this VMP update is limited to the control of the spread of the species into new areas as a result of the vegetation removal, and the establishment of control areas where elimination of the nuisance species from selected areas will be attempted. The control process is detailed in Chapter 5.

Common reed (*Phragmites australis*) is present in limited amounts within VMA 7 on the north side of the Runway 29 end. Control of this colony has been partly achieved through the past use of herbicides on the airport property. Common reed is capable of rapid colonization of adjacent areas through spreading by rhizomes and seed dispersal. It is particularly adapted to wetland soils on sunny landscapes, but is capable of colonizing upland areas as well as the flooded margins of water bodies.

Areas of European honeysuckle (*Lonicera xylosteum*) are common within the wooded wetlands at the Runway 23 end in Bedford (VMA 14), and the Runway 5 end in Lincoln (VMA 13). It is not a dominant shrub species in the subject areas, and occurs along the wetland/upland transition area. This shrub is spread mainly through seed dispersal (the berries are readily eaten by several wildlife species), and is found primarily in shaded conditions.

Japanese barberry (*Berberis thunbergii*) is common at the Runway 5 end in Lincoln (VMA 13). This small shrub is found in rich soils along the wetland/upland transition zone, principally in shaded habitat. It spreads primarily through seed dispersal. Though only a low shrub, it is capable of creating dense thickets that can eliminate other shrub species. Its dense, long thorns can restrict pedestrian access through areas.

G. Steep Slopes

The presence of restrictive topography will often dictate the available access routes to a VMA, or, where the steep slopes contain penetrations to navigable airspace, how the penetrations are to be removed. Slopes at the airport are generally not severe, and pose only a minimal constraint for access and obstruction removal.

Disturbance of soils on slopes exceeding 2:1 in grade create a high potential for erosion, and are difficult to stabilize with basic control techniques. Due to this problem, removal methods that minimize the potential for soil disturbance on steep slopes are to be utilized. These methods involve selecting access routes that avoid the slopes, and require the careful removal of felled timber to protect the soils.

The Elm Brook and Shawsheen River corridors (VMAs 4 and 9) contain steep and tall banks which could be impacted through vehicle access. Control of access to the vegetation on either side of the channels needs to be specified to protect the banks. Further discussion of the protection for these areas and access to the VMAs is provided in Chapter 5.

H. Organic Soils

Many wetland soils include a surface horizon of highly decomposed organic material. The hydrology required to develop this characteristic typically results in a soil that will not support machinery under normal conditions. Such soils are highly susceptible to disturbance from vegetation removal activities, thus the identification of these areas on the project site is required to reduce wetland impacts. Where the areas of these soils are too wide (i.e. greater than 100 feet) to allow vehicle access to penetrating vegetation, special removal techniques must be considered.

A reconnaissance survey of the site resulted in the identification of the following VMAs where all or portions of the soils within the wetland boundary contain a thick layer of decomposed organic material, and the area of poor soils is too wide to allow for access to penetrating vegetation by vehicles. The subject VMAs include the following: 3A, 3B, 3C, and 10. VMAs 4, 13, and 14 contain small areas of these soils; however, alternate access routes to these areas are available and will be used to avoid soil disturbance.

I. Historic/Archaeological Resources

Minuteman National Historic Park is south of Hanscom Field. The park boundary abuts one of the VMAs (VMA 13), however only minimal work is proposed adjacent to the park property boundary. None of the vegetation removal that will be required in the next 5-year cycle is visible from the park, nor will a reduction in visual buffer between the park and aircraft operating areas occur.

J. Closed Landfill Areas

Two capped landfills exist in the project area; one at the Runway 29 end adjacent to the southern portion of VMA 10, and one at the Runway 5 end within VMA 13. The use of vegetation removal equipment could damage the cap and/or liner material, thus special provisions are included in the VMP for work adjacent to the landfill areas. See Chapter 5 for further discussion of this topic. The VMA map provides the location of these two landfills.

CHAPTER 4: VEGETATION MANAGEMENT

This chapter provides a description of the vegetation management areas (VMAs) and removal plans addressed by this vegetation management plan (VMP) update. The VMAs are characterized in section A of this chapter, with additional information on the VMAs presented in the wildlife habitat descriptions located in Appendix A. The process of reviewing and selecting available vegetation removal methods for each VMA is described in section B. Section C describes the alternatives analysis performed to determine the primary removal method for each VMA. Section D provides thorough descriptions of the selected primary removal methods recommended for L.G. Hanscom Field, and section E provides descriptions of the selected secondary removal (maintenance) methods. Finally, the recommended yearly operational plans (YOPs) for the next five years of the plan are presented in section F. Note that the YOPs will include the most recent removal project, along with the continued maintenance of previous removal projects. Over time, the acreage of maintenance will increase, as the acreage of any new removal will greatly decrease. This will signify the attainment of one of the principle VMP objectives; the creation of low-growing vegetative communities.

The wildlife habitat focus areas provided in Appendix A provide descriptions of the condition of the VMAs at the start of the VMP process. Over time, portions of the VMAs will be modified as removal plans are implemented. Modifications include the conversion of wooded habitats to lower growing vegetative communities through the elimination of taller species over time. This plan provides overall management for all of the critical areas of L.G. Hanscom Field, through the development of VMAs. Each vegetation removal project will encompass small sections of each VMA, which will then be permitted as a separate removal project. Since vegetative characteristics change over time, the wildlife habitat focus areas included in this VMP provide baseline (pre-vegetation management) conditions for the VMP. As future projects are proposed under this VMP, updates of the habitat information will be required. Comparison to the baseline provides some measure of the loss/gain/change of wildlife habitat resulting from VMP implementation.

A. VMA Descriptions

Most areas surrounding the airport containing vegetation that currently penetrates, or has the potential to penetrate protected airspace, have been categorized into distinct vegetation management areas, or VMAs. Each VMA at L.G. Hanscom Field shall be managed based on the criteria and procedures outlined in this section. VMAs have been defined based on distinct vegetation communities in relation to other factors including topography, soil type, geographic location, and the elevations of airport protection zones. For example, areas within runway primary surfaces, which allow no objects higher than the nearest point of a runway centerline, and which are currently dominated by upland grass will have management objectives much different from an area at the outer portion of a runway approach surface that is dominated by mature trees and includes protected airspace that is considerably higher in elevation. The VMA Map included in the back pocket of this VMP provides the location of each of the VMAs identified at L.G. Hanscom Field. Where a VMA has multiple locations, then the VMA identifier number is followed by a letter on the map (i.e. VMAs 3A, 3B, and 3C).

Each VMA has a primary mechanical vegetation removal method associated with it. In addition, some areas include recommendations for use of secondary management techniques which include hand removal of saplings through selective thinning and/or herbicide treatment in accordance with the Massachusetts Wetlands Protection Act and other applicable state and federal regulations. ~~Controlled burns are only proposed as a potential secondary management technique since the environmental and personnel conditions necessary to complete the burn are quite rigid, and are not always available in each year that maintenance is required.~~

Table 4-1 provides a summary of the VMAs, the recommended primary and secondary removal methods, and comments on special conditions that may exist within each VMA. The corresponding wildlife habitat identifier for the VMA is provided in the comments section of the table. Habitat identifier forms are located in Appendix A of this VMP.

Table 4-1: *Summary Table of Vegetation Management Areas at L.G. Hanscom Field. Habitat identifier forms and associated habitat areas focus maps in Appendix A provide additional information for each VMA. The VMA Map attached to this VMP provides the location and boundaries of each VMA.*

VMA (Land Type)	Runway	Municipality	Primary Removal Method	Secondary Removal Method	Comments
1 (Upland)	All	Bedford Concord Lincoln	Standard Lawn Mowing	None	Includes the existing turf infield areas within the primary, approach, and transition surfaces of all runways. To be maintained with turf mowing equipment. Area is defined as rare species habitat for upland birds. Mowing is timed to avoid nesting areas, as recommended by the Massachusetts Audubon Society.
2 (Upland Wetland)	11	Bedford Concord	Selective Mechanized Felling	None	Mature forested upland and wetland a moderate distance from the runway end and beyond the approach light plane. Only mature trees to be removed with protection of shrub and sapling layers. Soils will support machinery during dry or frozen ground conditions. Three certified vernal pools that exist within the VMA require special removal procedures as outlined in Chapter 5 of this VMP. Habitat identifiers 11-10 through 11-15.
4 (Wetland)	11	Bedford Concord	Cut and Chip	Foliar Treatment and Invasive Species Control in Selected Areas	Includes the Elm Brook wetland corridor. Scrub-shrub and early successional forest in close proximity to runway end and approach light plane. Small trees and saplings to be selectively removed and processed while protecting non-penetrating vegetation. The narrow width of this VMA allows for vegetation removal from wetland edge, avoiding the streambank and overhanging shrub layer with machinery. No wood chips to be placed in wetlands or buffers except as approved by jurisdictional authority. Habitat identifier 11-1, 11-2 and 11-5.
5 (Upland Wetland)	11	Concord	Selective Mechanized Felling	Foliar Treatment and Selective Thinning	Elevated terrain and the close proximity to the runway end and approach light plane require maintenance of vegetation at shrub height or less. All tree growth within this VMA result in penetrations to protected airspace. Controlled burns used in the past as a maintenance tool. Initial mechanical removal technique was modified from the original VMP due to the growth of the trees which prohibit simple flail mowing for primary removal. Habitat identifiers 11-3, 11-4 and 11-6.

Table 4-1 (continued):

Summary Table of Vegetation Management Areas at L.G. Hanscom Field. Habitat identifier forms in Appendix A provide additional information for each VMA. The VMA Map attached to this VMP provides the location and boundaries of each VMA.

VMA (Land Type)	Runway	Municipality	Primary Removal Method	Secondary Removal Method	Comments
6 (Upland Wetland)	29	Bedford	Selective Mechanized Felling	Foliar Treatment and Invasive Species Control in Selected Areas	An area of mixed early successional vegetation and some mature trees within the transition surface Runway 29 and directly adjacent to residences. Selective removal of trees and saplings, with processing of the cut vegetation within upland staging area. Protect and preserve shrub and low sapling layer as an abutter screen. Non-certified vernal pool habitat exists within the VMA, so special protection of the site required during initial and secondary removal procedures as described in Chapter 5. No wood chips to be placed in wetlands or buffers except as approved by jurisdictional authority. No new removal in this VMP update.
7 (Wetland)	29	Bedford	Selective Mechanized Felling	Foliar Treatment	Early successional forested wetland within the approach surface, and close to the runway end. Contains high percentage of tree saplings and invasive shrub species. Maintenance of vegetation to ground level is required, since shrubs penetrate the approach surface in this area. Conversion of area to meadow habitat (without the grubbing of root systems) through mowing after tree removal will expand rare bird species habitat. Seeding with wetland seed mix will be required after mowing as specified in Chapter 5. Change from flail mowing in the original VMP necessary due to tree growth. No new removal in this VMP update.
8 (Upland)	29	Bedford Lexington	Clear and Grub	Standard Lawn Mowing	Upland areas along the Shawsheen River within the approach surface and the approach light plane. Much of the VMA is located within the outer riparian zone of the river. Maintenance of vegetation to ground level is required, since shrubs can penetrate the approach and light plane surfaces in this area. Conversion of the area to meadow habitat through mowing will expand rare bird species habitat, and will allow for easier future maintenance. Seeding will be required as specified in Chapter 5. Habitat identifier 29-1 and 29-2.
9 (Wetland)	29	Bedford	Cut and Chip	Foliar Treatment and Invasive Species Control in Selected Areas	Includes the Shawsheen River valley and adjacent inner riparian zone. Management includes selective removal of trees/saplings only, with encouragement of alder and dogwood growth by removing invasive shrub species. Steep banks and vegetation overhanging the water to be protected. No wood chips to be placed in wetlands or buffers except as approved by jurisdictional authority. Habitat identifier 29-4 and 29-5.

Table 4-1 (continued): Summary Table of Vegetation Management Areas at L.G. Hanscom Field. Habitat identifier forms in Appendix A provide additional information for each VMA. The VMA Map attached to this VMP provides the location and boundaries of each VMA.

VMA (Land Type)	Runway	Municipality	Primary Removal Method	Secondary Removal Method	Comments
10 (Wetland)	29	Bedford Lexington	Top-and-Girdle	Invasive Species Control in Selected Areas	Unstable soils, open water and limited access require top-and-girdle technique to protect wetlands. Avoidance of capped landfill with vegetation removal equipment required. Habitat identifier 29-6 and 29-10.
11 (Upland Wetland)	29	Bedford Lexington	Selective Mechanized Felling	None	Specific removal methods developed for work within the business parks. Large trees adjacent to buildings and parking areas require directional felling and strict coordination with the business parks. Individual tall tree removal from wetland areas. Habitat identifier 29-7.
12 (Upland)	5	Concord Lincoln	Clear and Grub	Standard Lawn Mowing	Elevated terrain and close proximity to the runway end require maintenance of vegetation to ground level since low shrubs can penetrate the transitional and/or approach surfaces. Creation of a field area within the upland is proposed which will expand the area of grassland habitat for rare bird species. 25-foot setback from wetland boundary required in this area. Habitat identifiers 5-1 and 5-3.
13 (Upland Wetland)	5	Concord Lincoln	Selective Mechanized Felling	Invasive Species Control in Selected Areas	Only large trees penetrate the approach and transition surface in this area. The identification and selective removal of these penetrations through mechanized felling is proposed. Special attention to the capped landfill and National Park boundary required. Soils will allow for the use of machinery during dry or frozen ground conditions to remove logs. Areas identified for buckthorn and honeysuckle control as part of secondary removal. Habitat identifiers 5-2 and 5-4.
14 (Upland Wetland)	23	Bedford	Selective Mechanized Felling	Invasive Species Control in Selected Areas	Only large trees penetrate the transition surface in this area. Soil conditions allow for the use of machinery during dry or frozen ground conditions. Beaver activity may result in flooding of portions of this VMA, requiring a modification to top-and-girdle in the future for portions of the VMA. White Pine is the principle target so secondary control not required for obstructions, but may be necessary for invasive species control. Habitat identifiers 23-1 and 23-2.

Table 4-1 (continued):

Summary Table of Vegetation Management Areas at L.G. Hanscom Field. Habitat identifier forms in Appendix A provide additional information for each VMA. The VMA Map attached to this VMP provides the location and boundaries of each VMA.

VMA (Land Type)	Runway	Municipality	Primary Removal Method	Secondary Removal Method	Comments
15 (Upland Wetland)	23	Bedford	Cut and Chip	Foliar Treatment or Selective Thinning	Shrub wetland within the approach surface, and close to the runway end. Contains high percentage of tree saplings and invasive shrub species. Maintenance of vegetation to shrub level is required, since saplings penetrate the approach surface in this area. Conversion of area to shrub wetland through selective thinning of the trees and saplings will create a maintainable wetland habitat. The surrounding upland area will be maintained as upland meadow. Seeding of the upland areas with an upland seed mix to be completed after mowing. Habitat identifiers 23-3 and 23-4
16 (Upland)	23	Bedford	Selective Mechanized Felling	None	Only the larger trees penetrate the transition surface in this area. Upland soils will support machinery. Shrubs and saplings to be protected as vegetation screen for adjacent residential area. Habitat identifiers 23-5 and 23-6.
17 (Upland Wetland)	23	Bedford	Not Identified	Not Identified	The management of penetrating vegetation within the Jordan Conservation Area and Hartwell Town Forest is being investigated as part of a separate but parallel process.

The following narrative describes each of the 16 VMAs identified for this VMP:

VMA 1: This VMA includes the turf infield areas within the primary, approach, and transitional surfaces of all runways. It is located within the towns of Bedford, Concord, and Lincoln. This area includes all primary surfaces. This VMA has been identified as containing grassland habitat for two state-listed rare bird species. The continued preservation of this area as grassland habitat, and continuation of the current mowing practices will preserve the habitat for the identified species. Massport has coordinated with the Massachusetts Audubon Society and the Massachusetts Natural Heritage and Endangered Species Program to study the on-site grassland bird populations. This effort is on-going.

Management includes the scheduled periodic mowing of these areas to restrict the establishment of woody vegetation, and to maintain the height of the vegetation at or near the runway surface elevation. No secondary management techniques are required for the existing turf areas. No modifications to the vegetative characteristics of this VMA are proposed.

VMA 2: This VMA includes the approach and transitional surfaces at the Runway 11 end within the towns of Bedford and Concord. It consists of mature forested upland and wetland areas that are located a moderate distance from the runway end and approach light plane. The gently rolling topography results in groups of trees on the higher ground penetrating the airspace, while trees within the low pockets are not likely to achieve an obstructing height. Only mature trees are identified as penetrations within this VMA in the current analysis. Dominant tree species include Red Maple (*Acer rubrum*), Red Oak (*Quercus rubra*), and White Pine (*Pinus strobus*). The soils within this VMA are capable of supporting machinery in dry or frozen ground conditions, and access is available through a myriad of gravel roadways that traverse the site. Upland staging areas are available throughout the VMA. The wetland areas within this VMA are small and narrow, allowing for tree removal from the wetland edge. Three certified vernal pools are shown to occur in the western half of the VMA in the 2006 edition of the Massachusetts Natural Heritage Atlas (Figure 3-1), requiring mitigation measures to protect the habitat as detailed in Chapter 5 of this VMP. Direct inspection of the three areas in 2008 revealed that successful amphibian breeding continues to occur in each of the three pools.

Secondary management of the cut areas is not required since only the tallest trees within this VMA penetrate protected airspace. As trees are removed, sapling and shrub density increases within the cut areas. As the smaller trees grow and penetrate the airspace, they will be removed in the future by subsequent mechanized felling operations. Modifications to the vegetative community include the creation of pockets of early successional woodland between the non-cleared mature forested areas. Protection of the vernal pools is important and is discussed in Chapter 5.

VMA 3: VMA 3 includes deciduous forested wetland areas within the approach and transitional surfaces at the Runway 11 end within Bedford and Concord. The wetlands are located within the watershed of Elm Brook, and border a portion of the brook channel, as well as several intermittent tributaries to the brook. The three areas of forested wetland contain seasonally flooded soils that will not typically support machinery. Beaver activity in portions of this VMA has exacerbated the poor soil conditions. The three areas are located a moderate distance from the runway end and are not within the approach light plane, thus only mature trees are identified as penetrations to the protected airspace. Selective topping and girdling of the mature trees is proposed to avoid soil alteration that would occur from skidding operations.

This technique requires only foot access to each obstruction.

VMA 3A includes an area within the transitional surface that borders directly on Elm Brook within the Town of Bedford. Access is restricted by the brook channel to the west, the property line to the north, and by other wetland areas with poor soils within VMA 4 to the east. Large Red Maple (*Acer rubrum*) dominate the canopy layer with some mature White Pine (*Pinus strobus*) along the wetland fringe.

VMA 3B is a mixed deciduous/coniferous forested wetland area within the approach surface, located just north and west of the approach light plane within the Town of Concord. Portions of this wetland area are quite narrow, and are to be cleared by dropping individual trees, and using a cable where necessary to drag the logs to the adjacent uplands. However; a portion of the wetland within VMA 3B is too wide to access from the adjacent uplands. Furthermore, beaver activity has impacted the soil conditions in some areas, and the dragging of logs could disturb the wetland soils in these locations. Thus, the use of a removal method that is sensitive to the poor soil conditions is required. Top-and-girdle may have to be used to address mature Red Maple (*Acer rubrum*) from the wetland interior. Where suitable soils along the fringe of VMA 3B exist, the primary removal method prescribed for VMA 5 will be used.

VMA 3C is a large contiguous forested wetland area associated with a tributary to Elm Brook within the Town of Concord. It is located over 1,500 feet from the runway end, in an area of slightly depressed elevation, thus mature trees are the only vegetation capable of penetrating protected airspace. Soil conditions along the wetland boundary are suitable to support machinery during dry or frozen ground conditions; however, the soils within the wetland interior are saturated to the surface, and would be impacted by ground removal even under dry or frozen ground conditions. Red Maple (*Acer rubrum*) and some Oak (*Quercus spp.*) are capable of penetrating the approach surface of Runway 11 in the wetland interior. Top-and-girdle of individual penetrating trees will be utilized where equipment access is not available.

Secondary management of the cut areas within VMA 3 is not proposed since only the tallest trees penetrate the protected airspace. Stump regrowth, shrubs, and saplings will grow in response to the increased light penetration, restoring the wetland functions of the area. As the existing smaller trees grow and become obstructions, they will need to be removed during a future mechanized felling project. The principle vegetative characteristics of this VMA will not be significantly modified by the work as only individual locations require management. Most of VMA 3C is not expected to require large scale management in one removal operation.

VMA 4: This VMA includes a portion of the Elm Brook corridor, and an area of scrub-shrub wetland within the approach and transitional surfaces of Runway 11 within Bedford and Concord. Moderately steep slopes occur along the brook channel and within the northeast shrub wetland of this VMA. It is located close to the runway end, and the ground is similar in elevation to the runway, thus both trees and saplings are capable of penetrating the protected airspace. Most of the VMA is capable of supporting machinery, and only low vegetation presently exists in the area. Thus, the selective removal of small trees and saplings, and chipping of this small vegetation within the adjacent uplands is proposed. The maintenance of a dense shrub layer throughout this VMA will preserve the wetland functions, and also inhibit the establishment of trees. Machinery will not be allowed to cross the stream channel to access vegetation. Rather, all removal will occur from the wetland edge, and shrubs that currently overhang the channel will be protected.

This VMA is located within a critical area directly at the runway end, thus secondary management techniques are required to maintain a low cover of vegetation. An initial foliar treatment of tree species will be completed following the mechanical removal. Once the VMA has been reduced in shrub/sapling density, the use of foliar treatment will be used on tree species re-sprouts to maintain the VMA.

The control of invasive species within the wetland boundary along Elm Brook from the approach light access road northward to a straight line between wetland flag 3318 and 3378 is proposed as a mitigation strategy in this area. After the mechanical removal of obstructions as described above, the selective removal of invasive shrub species from the wetland boundary will be practiced, while protecting native shrub species. The goal is to control the invasive species until the density of native shrubs within the area is sufficient to suppress buckthorn and honeysuckle. The periodic inspection and foliar treatment of target species shall be practiced until native shrub densities approaching 40% cover have been realized (as measured within a random 15-foot radius circle within the mitigation area based on leaf-on conditions).

VMA 5: This combination of wetland and upland area consists of a dense area of shrubs and saplings within the approach and transition surfaces, as well as the approach light plane of Runway 11 within both Bedford and Concord. The VMA occurs close to the runway end, and contains areas that are both slightly below and above the runway elevation. Due to this close proximity to the runway end and the sections of elevated terrain, tall shrubs, saplings and trees are all capable of penetrating the protected airspace, and obscuring the light plane to the runway end. Maintenance of the vegetation to a low shrub cover is required. Red Oak (*Quercus rubra*), Scrub Oak (*Quercus ilicifolia*), and Black Cherry (*Prunus serotina*) dominate the sapling layer, while Sweet Fern (*Comptonia peregrina*), Lowbush Blueberry (*Vaccinium angustifolia*), and European Buckthorn (*Rhamnus frangula*) are common within the low-to-medium shrub layer. Preservation of the low shrubs while eliminating the taller vegetation is the objective in this VMA. The flail mowing technique will be used as the initial removal method.

Like VMA 4, this VMA is located within a critical area directly at the runway end, thus secondary management techniques are required to maintain a low cover of vegetation. Foliar treatment (selective application of herbicides to the leaves of target vegetation) of tree species will be completed following the mechanical removal to address tree re-growth. Once the VMA has been reduced in shrub/sapling density, the use of periodic foliar treatment to treat tree re-growth is proposed. ~~and controlled burning techniques as described in Appendix F of this VMP will be used to maintain the VMA if conditions allow. Further herbicide applications and/or selective thinning of tree saplings will be required if conditions do not allow for the use of a controlled burn.~~

VMA 6: This combination of scrub-shrub wetland and shrub upland area occurs within the transition surface of Runway 29 close to the runway end within the Town of Bedford. The terrain is slightly elevated from the runway elevation. It borders the northeastern property boundary of the airport, where there is an area of residential development. The wetland portion of this VMA contains a pooling area known to support vernal pool species. The soils are capable of supporting machinery under dry or frozen ground conditions. Surface water is absent except for the small pool area that typically contains water into the early summer months. Vegetation in this area consists of a moderate layer of low trees including Gray Birch (*Betula populifolia*), White Pine (*Pinus strobus*), and Red Maple (*Acer rubrum*), and a dense

shrub layer of European Buckthorn (*Rhamnus frangula*) and Highbush Blueberry (*Vaccinium corymbosum*). Elimination of the mature trees and tall saplings while maintaining the shrubs and low saplings is the objective for this area. The tall shrubs and saplings will maintain a visual screen between the runway and the adjacent residences, and will also preserve the wetland functions of the area. Special consideration of the vernal pool habitat requires the directional felling of vegetation, the avoidance of herbicide applications close to the water's edge, and the avoidance of continuous erosion control barriers during the amphibian migration period.

Protection and enhancement of the shrub layer and the elimination of mature tree species are objectives within this VMA. Secondary management will include the application of a foliar treatment to tree species within the cut area, and the periodic removal of individual saplings as a standard maintenance practice. The improved sunlight conditions will enhance the shrub and sapling layer within the wetland and upland, providing a screen for adjacent residences and improved habitat functioning.

VMA 7: This VMA consists of an early successional forested wetland within the approach and transitional surfaces of Runway 29 in the Town of Bedford. It is located immediately at the runway end, and at a similar elevation. Within this VMA, vegetation as low as 8 feet in height penetrates the approach surface. The wetland drains to the east via an intermittent drainage ditch with eventual discharge to the Shawsheen River. Soil conditions will allow for the use of machinery for vegetation removal under dry or frozen ground conditions. Tree sapling coverage is dense throughout the wetland, and there is a dense shrub layer consisting of several wetland species, but dominated by European Buckthorn (*Rhamnus frangula*). Due to the low elevation of the protected surface over this wetland, conversion of the scrub-shrub wetland to a wet meadow condition is proposed through the use of a wetland seed mix. The boundary between this VMA and VMA 6 is well short of the plantings that were completed as part of the 1995 vegetation removal project, and is also outside of the 100-foot habitat limit of the non-certified vernal pool.

Secondary management is critical within this VMA due to the close proximity to the runway end and the dense sapling growth that is comprised of species that will re-sprout immediately after cutting. The application of a foliar treatment is required to control the re-sprouts, and to allow the herbaceous wetland species in the seed mix to colonize the cut areas. While this methodology will result in a loss of scrub-shrub habitat, there will be a conversion to wet meadow habitat which is a rare wetland cover type in the area. Caution tape will be used to define the exact limit of the vegetation removal in the vicinity of the vernal pool during the mechanical removal process. ~~Prescribed burns would be a good secondary management method but will not be used due to the proximity to a residential neighborhood.~~

Portions of VMA 7 were managed as a part of the 2003/2004 removal project. Maintenance is on-going in the removal area, as conversion to a wet meadow is not yet complete.

VMA 8: VMA 8 includes upland areas along the east and west bank of the Shawsheen River in the Towns of Bedford and Lexington. Most of this VMA is within the outer riparian zone of the river as defined in the Massachusetts Wetlands Protection Act Regulations. The edge of this VMA ends at the inner riparian zone. It is located within the approach light plane, and the approach and transitional surfaces of Runway 29. The vegetation borders the turf areas surrounding the runway, and consists of a dense cover of deciduous saplings and shrubs

including Black Cherry (*Prunus serotina*), Quaking Aspen (*Populus tremula*), Red Oak (*Quercus rubra*), and European Buckthorn (*Rhamnus frangula*). Due to the close proximity of the vegetation to the runway end and light plane, and the elevated terrain, even low vegetation penetrates protected surfaces. Management of this area through clearing and grubbing will result in the establishment of a mowable herbaceous surface, adding to the field habitat that presently exists within the turf areas of the airport. The upland shrub layer will be cleared and grubbed, and the area will be seeded with an upland seed mix. Erosion control barriers will be used as necessary to protect adjacent wetlands.

Once established, the turf will be maintained along with the adjacent existing field areas. Secondary management of this VMA will involve periodic mowing of the established turf.

VMA 9: This wetland VMA includes the section of the Shawsheen River corridor that is located within a deep channel at the Runway 29 end within the Town of Bedford. The channel is located within the approach light plane, as well as the approach and transitional surfaces. The river is contained within a trapezoidal valley with steep side slopes. The river channel is approximately 12 feet wide within the valley, and is approximately 15-20 feet below the elevation of the surrounding upland areas. Most vegetation that grows within the valley does not penetrate the airspace due to the elevation difference, however tree saplings near the top of the side slopes, and mature trees along the river bank are obstructions (primarily Red Maple (*Acer rubrum*)). Management includes the hand removal of vegetation that extends above the upland elevation. The bank areas will not support machinery, thus the processing of removed vegetation will occur within adjacent uplands. Since only large saplings penetrate the airspace, and open water is present, no herbicide application is proposed within 10 feet of the bank limit. Rather, hand removal of saplings as they penetrate the top of the gully will be performed.

VMA 10: VMA 10 consists of mixed deciduous/coniferous forested wetland and scrub-shrub swamp along the Shawsheen River and a tributary to the river within both Bedford and Lexington. Similar to VMAs 8 and 9, it is located within several protected airspace surfaces at the Runway 29 end, including the approach light plane. This VMA is located further out in the runway approach, thus only mature trees, dominated by Red Maple (*Acer rubrum*) and White Pine (*Pinus strobus*), penetrate protected airspace. Beaver activity and ponded areas restrict the use of ground vehicles for vegetation removal. Access to the taller vegetation within the VMA from adjacent uplands is not an alternative due to the width of the wetland. Helicopter removal of logs that are felled by hand is proposed in order to protect the wetland soils from damage that would occur from skidding operations. Directional felling of trees away from the river channel and ponding areas will be necessary. Top-and-girdle technique will be used to address the obstructing portions of individual trees.

A capped landfill occurs along the southern boundary of VMA 10 on the Bedford/Lexington boundary. No vegetation removal vehicles or tree felling associated with this project shall occur on the cap or the maintained landfill slope area.

VMA 11: This mix of upland and wetland vegetation is located along the roadways and buildings of the business parks at the Runway 29 end within both Bedford and Lexington. It is located within the approach surface of the runway, but is quite distant from the runway end. Only mature trees penetrate the approach surface within this VMA, with White Pine (*Pinus strobus*) as the dominant tree species. Individual large Red Maple (*Acer rubrum*) and Red Oak (*Quercus rubra*) also penetrate the airspace in this VMA. Selective removal of large trees within

easement areas will be completed with strict coordination with the business parks and other off-airport properties. The wetland areas within this VMA are small, and the trees to be removed are accessible by machinery.

No secondary management of the cut stumps is proposed since only the tallest vegetation penetrates the protected airspace within this VMA. The proposed management will not significantly modify the vegetative characteristics of the area.

VMA 12: VMA 12 consists of an early successional upland area dominated by tree saplings including Quaking and Big-tooth Aspen (*Populus tremula* and *grandidentata*), Red Oak (*Quercus rubra*), and American Elm (*Ulmus americana*). It is located within both Lincoln and Concord. The shrub layer is limited due to the high sapling density. It is located in an area of elevated terrain within the approach and transitional surfaces across Virginia Road from the Runway 5 end. The terrain is higher than the runway elevation, which exacerbates the penetration problem within the VMA, and saplings and trees penetrate the protected surfaces. Management of most of the area as a mowable herbaceous field is proposed. The extreme north and south portions of this VMA are sufficiently removed from the approach surface so that management as a scrub-shrub upland could be proposed. Erosion control barriers will be needed to protect the adjacent wetland area during stabilization of the soils within the VMA after the clearing/grubbing operation. A 25-foot setback from the wetland boundary will be established with the erosion control barrier prior to the grubbing of the root systems.

Secondary management of this VMA will involve the scheduled periodic mowing of the established turf, or the herbicide treatment of stumps in non clearing/grubbing areas. Once the area is cleared and grubbed of root systems, the soils will be seeded with an upland seed mix specified in this VMP. Once established, the turf will be maintained along with the adjacent existing field area. Erosion controls are needed to protect the adjacent wetland area until vegetation is established.

VMA 13: This VMA is located further south in the approach of Runway 5 than VMA 12, and the ground elevation drops from the boundary between the two VMAs to the southern boundary of VMA 13. It is located in the Towns of Lincoln and Concord. The combination of increased distance from the runway end and the lower topography results in a significant decrease in the number of airspace penetrations. In this area, only mature trees are capable of penetrating the approach and transitional surfaces, with Red Maple (*Acer rubrum*), Red Oak (*Quercus rubra*), and White Pine (*Pinus strobus*) the most common large trees. The VMA includes both wetlands and uplands. Vegetation management is restricted to the wetland fringe where soils are capable of supporting machinery during dry or frozen ground conditions. Further within the wetland interior, saturation to the soil surface occurs, and the soils do not support trees, and thus the interior does not contain penetrations. If individual trees at the edge of the marsh area must be removed, evaluation of access on a case-by-case basis will be required. If soil conditions prevent access to an area, a modification to top-and-girdle will be needed as was completed in the first removal project in 2003.

A capped landfill exists within VMA 13 that has some obstructing vegetation located along the perimeter of the cap. Access to the vegetation with machinery would require work on the landfill that could potentially damage the liner. To avoid this impact, trees along the perimeter of the cap will be felled by hand away from the landfill, and processed in place. The logs and slash will be reduced and allowed to rot in place, thus avoiding any vehicles on the landfill liner.

Secondary management of the cut areas is not required since only the tallest trees within this VMA penetrate protected airspace. As trees are removed, sapling and shrub density increases within the cut areas. As the smaller trees grow and penetrate the airspace, they will be removed in the future by another mechanized felling. The proposed management will not significantly modify the characteristics of the area.

The control of invasive species within portions of this VMA is proposed as a mitigation strategy in this area. After the mechanical removal of obstructions as described above, the selective removal of invasive shrub species from the limits of the cut areas of Wet-1 and Up-3 will be practiced, while protecting native shrub species. The goal is to control the invasive species until the density of native shrubs within the area is sufficient to suppress buckthorn and honeysuckle. The periodic inspection and foliar treatment of target species shall be practiced until native shrub densities approaching 40% cover have been realized (as measured within a random 15-foot radius circle within the mitigation area based on leaf-on conditions).

VMA 14: This VMA consists of an area of mature coniferous forested wetland and upland within the transitional surface of Runway 23 in the Town of Bedford. Mature White Pine (*Pinus strobus*) are principally responsible for penetrations to the protected airspace in this area. The wetland contains some small pockets of unsuitable soils; however, access to these areas from adjacent stable soils will allow ground removal within the VMA. Beaver activity is significant within the adjacent wetland areas and new water diversions may alter the soil characteristics. Should this occur, a modification to helicopter removal or topping and girdling may be required for a portion of the VMA. Management of this area includes the removal of the mature trees only, with protection of the sapling and shrub layers. Secondary management of the cut stumps is not required, since only the tallest trees within this VMA penetrate the protected airspace, and most of the trees to be removed consist of coniferous species. Control of invasive shrubs through foliar treatments was practiced after the initial removal project in 2003.

VMA 15: This VMA, in the town of Bedford, consists of a mix of upland and wetland scrub-shrub areas directly at the end of Runway 23 within the approach and transitional surfaces. A drainage ditch exists along the runway perimeter roadway, and tall shrubs and saplings that exist along the ditch penetrate the protected airspace. Dominant tree species include Red Maple (*Acer rubrum*), Gray Birch (*Betula populifolia*), and Quaking Aspen (*Populus tremula*). Due to the close proximity of this VMA to the runway end, and the similar terrain elevation, all saplings are to be removed with preservation of the shrub layer within the wetland boundary. The upland sections will be mowed to ground level, and seeded with an upland seed mix. Maintenance of the upland areas as meadow habitat is proposed. The VMA is accessible from stable soils on either side of the subject vegetation, and removal can be completed easily from stable areas by reaching with the cutting equipment, or cutting by hand and dragging the cut vegetation out of the wetland area. The cut and chip technique is prescribed for the wetland areas in VMA 15, where access across the surrounding wetland ditches is not possible for flail mowing equipment.

It should be noted that a runway safety area project has been approved that will modify uplands and wetlands in this area. An update to the VMA description and prescribed management techniques may be necessary at the completion of the runway safety area project.

This VMA is located within the area directly at the runway end, thus secondary management

techniques are required to maintain a low cover of vegetation. Following the mechanical removal, there will be a foliar treatment of tree re-growth followed by selective thinning of saplings within the wetland boundary.

VMA 16: VMA 16 includes a mature upland forested area within the transitional surface of Runway 23. The northernmost area of the VMA borders a residential area. The VMA occurs along the side of a moderate slope that is slightly higher than the runway elevation. Mature Oak (*Quercus spp.*), Quaking Aspen (*Populus tremula*) and some individual White Pine (*Pinus strobus*) penetrate the protected airspace in this area. The soils are capable of supporting ground removal of the individual trees. Shrub and sapling layers are to be preserved in the northern portion of the VMA as a screen for adjacent residences. Secondary management of the VMA is not required since only the tallest trees penetrate the protected airspace.

VMA 17: This VMA is not located on Massport property. It is located directly within the approach of Runway 23 immediately north of the property boundary. It is an area of mature trees that penetrate the approach and transitional surfaces of Runway 23 has been identified in Bedford's Jordan Conservation Area. The management of the penetrating vegetation in this area will be addressed through meetings with the Town of Bedford. The selected management techniques will be included in a future update of this VMP.

B. Selection of Vegetation Removal Methods

An objective of this VMP is to eliminate or control the growth of woody vegetation that threatens protected airspace at L.G. Hanscom Field. To achieve this objective, the selection of an initial removal method that addresses the penetration and creates a maintainable vegetative community, but also is sensitive to environmental resources is required. Once a removal project is completed, it is necessary within many VMAs to address the re-growth of the vegetation from stumps, especially where the elevation of the protected airspace is close to the ground elevation. Examples of the problem of re-growth exist at the airport as a result of the 1995 clearing project. Dense and tall re-growth exists from most of the stumps within the previous management areas since secondary management techniques were not included in the project. To address this maintenance and project longevity issue, secondary vegetation management methods were incorporated into the 2003 VMP and are also considered and proposed in this VMP update in accordance with Section 5.2 of the GEIR for Vegetation Removal at Public Use Airports.

Analysis of the characteristics of the vegetation within the vegetation management areas (VMAs) was an integral part of the preparation of this VMP update, as shown in the habitat identifier forms in Appendix A. Such analysis is required to determine the most appropriate minimum impact vegetation management methods for a particular VMA. Each selected removal method considers environmental impacts, project longevity, ease of maintenance, and cost effectiveness. Environmental resources to be considered include wetlands, water quality, rare species habitat, topography, soil stability, abutter screening, historical/archaeological resources, and accessibility. Project longevity is directly related to environmental sensitivity and cost effectiveness, since the frequency of completing vegetation removal projects has both environmental impact and cost implications. Ease of maintenance is an important consideration when determining removal methods, because the ability of the airport to control future re-growth of vegetation into protected airspace directly impacts the initial project longevity, as well as the future costs and environmental impact of vegetation management at the airport.

The 2003 VMP included the control of invasive plant species using herbicide treatments. This effort was proposed as mitigation of wetland impacts resulting from vegetation management efforts. Several removal areas in the 2003 VMP were designated for invasive species control, and included both wetland areas and wetland buffers. Herbicides were applied in years 2 through 5 of the 2003 VMP process. Monitoring of the invasives was conducted in these areas as a part of the control program. The effort resulted in significant reduction of invasives in the control area, but outright elimination was not achieved. An objective of the herbicide treatment program was to control the numbers of invasives while protecting the native shrubs. The temporary control was to allow for a competitive advantage of the natives over the invasive species, thereby contributing to one of the overall VMP objectives of creating low-growing vegetative communities with a focus on native species. The results of the program were impressive, but further control through the next process appears warranted to encourage coverage of native species.

Additionally, the 2003 effort included research efforts to improve future VMP activities. One such effort was the comparison of the clear/grub technique to the use of herbicide in the conversion of a scrub-shrub wetland to a wet meadow. The results show that careful clear/grub methodology combined with the application of a wetland seed mix clearly provides a more successful post-clearing wetland community in terms of wetland plant coverage and overall wetland functions and values. Seed mix success in the grubbed area was more than twice as successful as the application of seed to non-grubbed ground area where herbicides alone were used to remove shrubs and saplings. Strict control of herbaceous invasives (i.e. purple loosestrife) in the grubbed areas was necessary for the first 3-5 years after seeding. Hand pulling of loosestrife from the plot was practiced annually.

The use of nursery stock shrubs to assist in the revegetation of managed areas was also attempted in the 2003 VMP program. Four hundred native shrubs were planted in wetlands and wetland buffer zones in an area where saplings and invasives were controlled using herbicide applications. Significant predation of the nursery stock by whitetail deer occurred, even though plastic mesh netting was applied to each planting. Crowding by adjacent, naturally occurring shrubs and groundcover also resulted in mortality of the nursery stock. Overall, it appears that 50% mortality was experienced by the nursery stock, while the planted area has re-vegetated naturally at a high rate. Invasives control, while protecting natural regrowth of native species, appears to be a more efficient way of revegetating wetlands and wetland buffers in comparison to the use of nursery stock. If used in the future, a concentrated planting of select problem areas would appear to be more beneficial in comparison to a lower density planting of a wider area.

The selection of appropriate vegetation removal methods involves a review of the techniques outlined in the Vegetation GEIR including physical, chemical, combination physical/chemical, and non-equipment/non-chemical methods. Each of the methods is assigned a "tier classification" that corresponds to its level of potential impact. A listing of the available removal methods from the Vegetation GEIR and their associated "tier classifications" are provided in Table 4-2.

Table 4-2: *Listing of available vegetation management methods with associated tier classifications from Section 5.2 of the Final Generic Environmental Impact Report (GEIR) for Vegetation Removal at Public Use Airports*

GEIR-Listed Management Method	Tier Classification
<u>Physical Methods</u> Push Trees Over Pull Trees Down Shear Trees with a Bulldozer Mechanized Felling Build an Impoundment (flooding) *Remove Trees by Helicopter Clear and Grub	High Impact Moderate Impact High Impact Moderate Impact High Impact Minimal Impact High Impact
<u>Chemical Methods</u> Fell/Lop/Cut-Surface Treatment Fell/Frill-and-Inject Treatment Fell/Selective Basal Treatment Selective Foliar Treatment	Low Impact Low Impact Low Impact Moderate Impact
<u>Combined Physical/Chemical Methods</u> Frill-and-Inject/Pull Trees Down Frill-and-Inject/Push Trees Over Mechanized Felling/Cut Surface Treatment Shear Trees with Bulldozer/Cut-Surface Treatment	Moderate Impact High Impact Moderate Impact High Impact
<u>Non-Equipment / Non-Chemical Methods</u> Fell Trees and Lop Slash Top Trees Girdle Trees Prescribed Burning	Minimal Impact Minimal Impact Minimal Impact High Impact

*Helicopter removal originally proposed in the VMP has been substantially replaced by top-and-girdle methodology.

Use of the guidelines for selection of vegetation removal alternatives (Section 5 of the GEIR) involves the use of a process that is based on:

- Size of the area requiring vegetation removal
- Elevation of the protected airspace surface compared to the ground surface
- Potential height of the dominant vegetative species
- Density of the trees and understory within the removal area
- Ability of the soils to support removal equipment
- Presence/absence of environmentally sensitive conditions
- Available funding

Each VMA was assessed for alternatives based upon these factors, resulting in the selection of the initial/secondary management techniques described in this chapter. The following section provides the alternatives analysis used to select the removal methods for the VMAs at L.G. Hanscom Field.

C. Alternatives Analysis

As part of the initial VMP, alternatives to vegetation removal were assessed including the “no action” and runway threshold displacement alternatives.

The “no action” alternative was considered for the project in order to establish a baseline for the project’s environmental effects. By not addressing any of the penetrations at L.G. Hanscom Field, the degree of penetration into protected airspace, in terms of the number of penetrations and the height of each, would increase on an annual basis within each of the VMAs. Many of the tree species identified as obstructions have growth rates of three feet or more per year, and few of the obstructions have reached full mature height. A “no action” alternative would impact the operations at the airport, potentially resulting in decreased runway lengths available for landings, modifications to approach categories, loss of control tower line-of-sight, and overall reduction in airport utility.

Runway displacement to avoid or minimize the extent of obstructions to the approach surface was also assessed, and was identified as not practicable. The use of the displaced threshold siting criteria to address approach obstructions would impact all runway ends, resulting in a significant reduction in the amount of runway length available for landings. This is especially critical on the Runway 11-29 which has precision instrument landing systems for each end.

Displacing a runway threshold does not address the obstructions within the transitional surface, and allows approach obstructions to continue to grow, requiring further displacements and an incremental loss of safety and utility of the airport. The combination of the reduced runway usage, the continued obstruction presence, the threat of continued future threshold displacements, and the overall degrading of the facility for aircraft use would compromise the substantial federal and state investment in the facility. Maintenance of the airport for the existing based aircraft cannot be achieved if displaced thresholds are used to address the approach obstructions. The no-action alternative is not feasible since it does not address current FAA regulations and does not maintain the condition of the navigable airspace around Hanscom Field.

Having identified the need to physically manage the vegetation within the protected airspace in order to address FAA safety regulations, the alternatives are reduced to the type of management selected for each VMA.

Table 4-3 presents a summary of the selection of the initial and secondary vegetation removal alternatives for each of the VMAs at L.G. Hanscom Field. In the table, the “height of vegetation to remain” refers to the height of the woody species within that VMA that will not be removed because the subject vegetative layer is below the protected airspace elevation and can be easily maintained. “Soil suitability” refers to the ability of equipment to be used in the VMA under dry or frozen ground conditions without causing significant disturbance of the soils. The suitability is determined through field investigation and not through the use of existing soil surveys. “Environmental sensitivity” refers to the presence of resources within the VMA that could be impacted by the selected removal methods such as rare species, vernal pools, and/or sensitive wetlands. “Re-growth capability” refers to the ability of the vegetation within the VMA to generate rapid re-growth from the cut surface that would penetrate protected airspace within a short period of time if secondary management were not practiced. The “re-growth capability” is determined by assessing the dominant species within the VMA, as they relate to the difference in elevation between the protected airspace and the ground surface.

Table 4-3: *Summary of information for each VMA at Hanscom Field used to select the initial and secondary vegetation removal methods for the Vegetation Management Plan. Data includes entire airport and is not limited to areas requiring actual vegetation removal within the next 5 years.*

VMA	Size of VMA	Height of Dominant Vegetation	Height of Vegetation to Remain	Soil Stability	Environmental Sensitivity	Re-growth Capability
1	567 acres (includes pavement)	< 1'	< 1'	Stable	High	N/A
2	117 acres	60-80'	< 50'	Stable	Moderate	Low
3	65 acres	20-60'	< 25'	Unstable	High	Moderate
4	23 acres	35'	< 15'	Stable	Moderate	High
5	55 acres	35'	< 5'	Stable	Low	High
6	12 acres	60'	< 15'	Stable	High	High
7	10 acres	30'	< 5'	Stable	Moderate	High
8	9 acres	25'	< 5'	Stable	Low	High
9	12 acres	45'	< 15'	Unstable	High	Moderate
10	21 acres	65'	< 25'	Unstable	Moderate	Moderate
11	70 acres	60-90'	< 50'	Stable	Low	Low
12	23 acres	40-65'	< 5'	Stable	Low	High
13	27 acres	60-85'	< 50'	Stable	Moderate	Low
14	19 acres	55-80'	< 50'	Stable	Moderate	Low
15	10 acres	30'	< 5'	Stable	Moderate	High
16	11 acres	50-60'	< 25'	Stable	Low	Low

Based on the information collected for each VMA and a comparison of the vegetation characteristics to the elevation and location of the protected airspace surfaces, management options were selected that minimized impacts to environmental resources while providing for a reasonably maintained VMA. The following general principles were followed in analyzing the VMA alternatives:

- Where only mature trees penetrate protected airspace within a VMA, removal methods that protect and preserve the understory were selected while non-selective removal methods that may result in significant damage to the understory were not considered.
- Where the elevations of the protected airspace surfaces are greater than 50 feet above the ground elevation within a VMA, re-growth of the cut vegetation was not considered to be an issue so secondary control methods were not proposed.
- Removal methods that result in the alteration of soils (push/pull trees, clearing and grubbing) were not considered for any wetland VMAs.

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- ~~Removal methods that result in standing dead timber (such as girdling) were not selected as a primary method due to the number of trees involved in the project, the safety implications of allowing dead vegetation to remain, and the labor intensiveness of these methods. However, the selective creation of snags is proposed as a wildlife habitat mitigation measure.~~
 - Herbicide application is restricted to direct foliar treatments after at least one year of re-growth due to the increased effectiveness over cut-stump or frill-and-inject treatments. Increased method effectiveness results in reduced volumes of herbicide and overall lower project costs.
 - Where unstable soils exist, removal methods that involve mechanized ground removal were not considered. Non-ground removal method alternatives were restricted to top-and-girdle since the subject VMAs are not conducive to high-lead logging based on VMA size, distance to staging areas, and soil conditions between the vegetation to be removed and the staging areas. High-lead logging is a means of removing cut vegetation from an area by means of high-tension cables strung above the area and eliminates the need to skid, or drag, trees along the ground. Helicopter removal, while included in the original version of the VMP, was not used as a primary removal technique based on the success and environmental sensitivity resulting from the top-and-girdle technique used in the 2003 clearing project.

Based on the above-noted principles, the number of alternatives considered for each of the VMAs was significantly reduced. The following methods from Table 4-2 were determined to be inappropriate:

- Push Trees Over/Pull Trees Down
Soil disturbance is excessive as the root mass is removed from the ground with the attached soil, requires heavy machinery access to each individual tree, which is not available in many locations addressed in this VMP, and cannot be used in wetland situations since it involves disturbance of the soil. There is high potential for the spread of invasive species when using this technique.
- Shear Trees with a Bulldozer:
While this method allows the root mass to remain in the ground, machinery access to each individual tree is required. A bulldozer exerts force on the soils to remove the tree, increasing the potential to alter the soils as compared to other available methods. Ground pressures developed by a bulldozer are much higher than those for typical logging machinery. Thus, the areas where this technique can be used are limited due to the presence of unstable soils on the site.
- Build an Impoundment:
The creation of open water areas to flood the penetrating vegetation in close proximity to aircraft movement areas is contrary to FAA policy since open water resources attract waterfowl which pose a hazard to aircraft. Additionally, the standing dead timber created by flooding often remains a penetration to the airspace, and must be removed anyway. Impoundment creation may also be subject to the Department of Environmental Management Dam Safety Regulations, which require a thorough engineering design for any created dam. This would be a costly option and would not fully achieve the goals of the project.
- Cut Surface Treatments (Herbicide Application):
The application of herbicides to freshly cut vegetation as a cut surface, frill-and-inject,

and/or basal treatment has a lower success rate as compared to foliar treatments following at least one season of re-growth. Over the long-term, the improved success of the selected application technique will result in lower herbicide volumes and improved project longevity. Cut surface treatments typically require a more concentrated solution of herbicide (up to a 50% solution compared to 7-15% solutions for foliar applications). The higher concentrations combined with the lower success rate results in overall higher volumes of herbicide, increased project costs, and more intensive labor.

- Combination Physical/Chemical Methods:

All of the available combination methods utilized the immediate application of herbicides to the cut vegetation, which has been shown to have a lower success rate than selective foliar treatments of re-growth.

After eliminating the above removal/management methods, the remaining alternatives were reviewed. The assessment considered removing all vegetation (including the root systems), allowing only vegetation that would not likely penetrate the protected airspace to remain (selective removal), or allowing all vegetation to remain but reducing it in height to below the airspace elevation (topping). Topping was initially not selected for any of the VMAs in 2003 for the following reasons:

- Topping requires direct access to each individual penetration and access to the top of the penetration using either a type of lift truck or climbing the vegetation. This is a labor intensive action posing a higher degree of hazard to the work crew than other removal methods. Access to each tree with a lift truck involves a greater degree of incidental damage over selected clearing methods, since direct access to the base of each tree by heavy equipment is not required for the mechanized felling option.
- Access to many of the VMAs is constrained by soil conditions, thus topping with the use of a lift vehicle would be infeasible in those areas.
- The exact elevation of each penetration or group of penetrations would have to be determined so that the correct topping height is known. This would likely require ground survey of each penetration.
- Topping results in only a short-term gain, as re-growth would be rapid, requiring a new project within 2-3 years of the action. Maintenance of the topped areas is not feasible due to the number of penetrations existing at the airport.
- Many of the penetrations involve White Pine and Pitch Pine, which would die after topping resulting in standing dead timber.

However; based on the results of the 2003 removal project, topping has been determined to be an effective technique in some VMAs. It was also found to be feasible without the need for a lift vehicle. Skilled professional climbers were able to access target trees, and remove the obstructing portion. Further reduction of the dropped limbs on the ground was required to reduce the mulching effect of the downed limbs. All cut vegetation remained at the tree base. This technique was found to be suitable where small areas of trees similar in height exist, and direct view of the tree tops was observable from open ground so that survey could be performed on the cut tops to ensure adequate removal heights. Additionally, the area had to be well removed from any pedestrian activity or structures. The issue of re-growth was addressed through the girdling of all topped trees, which stunted their growth and resulted in the elimination of the tree over an approximate 3-5 year period.

Based on a thorough review of the available techniques versus the airspace, ground and plant community conditions at Hanscom, the extent of plant community conversion for the VMAs at Hanscom were evaluated. The following provides the degree of anticipated plant community conversion necessary for the Hanscom VMAs.

Removal (conversion) of all Vegetation: VMAs 5, 7, 8, 12
Selective Removal of Vegetation: VMAs 2, 3, 4, 6, 9, 10, 11, 13, 14, 15, 16

Having identified the type of vegetative community to be established, the remaining available vegetation removal methods were considered for each of the VMAs. In the list of selection principles, the narrowing of the alternatives based on environmental conditions is presented. Soil alteration and VMA access were two of the primary considerations in determining the initial removal method. Where unstable soils and/or limited site access were identified within a VMA, the lowest impact alternative was selected (helicopter removal or top-and-girdle). Where stable soil conditions allowed for machinery use and access, the height of the vegetation that could remain in the VMA determined the removal method. Where shrubs were to be protected, a selective removal was proposed (cut and chip, or mechanized felling depending upon the diameter of the vegetation to be removed). Where shrubs penetrated the protected airspace in the stable soil areas, mowing (wetlands) or clear and grub (uplands), with a conversion to meadow habitat was proposed.

The alternatives analysis resulted in the application of the principle of Integrated Vegetation Management to each of the VMAs. Removal methods were carefully selected based on environmental constraints, airspace elevation, and ground elevation. Then, the need for secondary measures to control re-growth within the VMA was assessed, and methods selected where appropriate. The use of the initial and secondary removal methods establishes a vegetative community within each VMA that is maintainable in the long-term, thus addressing the safety requirements of the airport for many years, and reducing the need for large scale projects in the cut areas in the future.

D. Selected Primary Removal Methods

The following section provides a description of the selected vegetation removal methods to be utilized at L.G. Hanscom Field. The selection of the appropriate removal methods was based on a host of factors, including the height and diameter of the obstructions, the ground/soil conditions, the height of the protected airspace above the VMA, and the accessibility of the particular VMA. Where vegetation at shrub height penetrates the navigable airspace, the complete removal of the woody species, typically through mowing, is specified. However, where only trees have the ability to penetrate, selective mechanized clearing and protection of the shrub layer is specified. A summary of the removal methods to be used is provided in Table 4-4. Work within wetlands and buffers will not be performed until Massport has secured all necessary permits for each removal project under this phase of the VMP.

Table 4-4: *Summary of Primary Recommended Vegetation Removal Methods for the Vegetation Management Areas at L.G. Hanscom Field*

Initial Removal Method	Applicable VMAs	Height of Vegetation to Remain	Comments
Mowing, Grass Areas (using standard equipment)	1	<12"	Regular maintenance of grassy areas using standard landscape mowing equipment.
Mowing, Woody Vegetation (using flail-type equipment)	7, 15	<5'	Maximum ground surface loading restrictions will be imposed by Massport during any contracts for work in wetlands that are capable of supporting equipment. Dry or frozen ground conditions will also be required.
Clear and Grub	8, 12	<12"	Upland area is converted from woody vegetation to grass to provide for long-term maintenance by grass mowers. Slash and root systems are removed from the site. Existing topsoil is graded as needed, and seeded with an appropriate seed mix.
Cut and Chip	4, 9, 14, 15	<15	Cut vegetation will be lifted or hand carried out of project area and chipped into trucks within staging areas for removal from airport site. No chips will be spread onto ground surface. Intention of removal method is to protect non-target vegetation during removal, and to promote the growth of a dense shrub layer. A highly selective removal method specified for environmentally sensitive areas where smaller diameter vegetation is to be removed.
Mechanized Felling	2, 5, 6, 11, 13, 16	Variable	These areas generally include selective removal of tall trees where a significant understory of shorter trees is allowed to remain. A somewhat selective removal method that does not significantly modify the vegetative community. Specified for areas of mature trees where suitable access to the obstructing vegetation is available.
Helicopter Removal Top-and-Girdle	3, 10	Variable	Allow shrub and sapling layers to remain. Provides for protection of unstable soil in wetland areas while removing mature trees that penetrate the airspace. Hand clearing with chain saws by climbing crews will be followed by reducing the slash on the ground. A minimal impact removal method.

Mowing, Grass Areas

Mowing in grass areas is a regularly performed airport maintenance operation to maintain those areas in proximity to runways, taxiways, safety areas, and other operational areas of the airport. These areas are mowed to provide clear lines of sight and to prevent woody vegetation from encroaching into these areas. Standard tractor-type equipment is used. Vegetation in these areas is generally maintained at 12 inches or less.

Mowing, Woody Vegetation

This removal method is reserved for those areas where even saplings and tall shrub species are able to penetrate the protected airspace, which typically occurs in areas in close proximity to the primary surface, and within the initial section of the approach surface. Mowing is only used where stable soils are present under dry or frozen conditions, or where only a short reach is required over unstable areas to access the target vegetation. Flail mowers can reach approximately 15 feet over unstable areas.

Mowing will be performed by mechanical shredding of woody vegetation down to near ground level using a tracked or tired vehicle that exerts low ground pressures. In VMA 7, conversion to a meadow is proposed thus removal to ground level will occur. In VMAs 5 and 15, the establishment of a low shrub layer is proposed, thus mowing will be restricted to saplings and tall shrubs. Vegetation is converted to a fine, evenly spread mulch. Erosion control barriers are not typically required in these areas, however the use of seed and mulch to protect areas with no groundcover is specified. This removal method will result in the re-establishment of a low shrub layer or grassland habitat, and saplings will be subject to periodic removal as part of the long-term maintenance of the areas. It is recommended that these mowing areas be treated with a foliar herbicide application to eradicate tree saplings.

The use of flail mowing in VMAs 5 and 15 was limited after the 2003 removal project. The continued growth of the vegetation at the airport has resulted in a reduced area where flail mowing can be practiced. When the occurrence of tree species with a diameter exceeding 6 inches becomes too high, then mechanized felling replaces the flail mowing equipment. As the VMP updates are generated, the phasing out of this technique will likely occur.

Clear and Grub

This upland method includes removal of all woody vegetation to ground level. Grubbing shall involve the mechanical removal of all root systems, and the entire area will then be graded, topsoiled and seeded. All grubbing debris will be removed from the site. No grubbing within any wetland area is recommended in this VMP. Erosion control barriers are typically established along the downslope area to protect adjacent wetlands. This removal method will provide for easier long-term maintenance of the area as grassland.

Cut and Chip

This removal method is specified where tall shrubs, tree saplings, and small trees are the obstructing vegetation, and preservation of a low shrub layer is an objective. This method will include hand cutting of target woody vegetation in the most sensitive areas. Additionally, this

method is specified where soil conditions prohibit equipment access to all or part of the VMA, requiring the hand carrying or cabling of trees to a staging location for processing and removal from the project site. No wood chips will be deposited on the surface of the ground. Vegetation subject to cut and chip removal is highly selective, and results in the protection of the shrub and groundcover layers. Cut areas will be subject to herbicide application to control re-growth from stumps.

The locations of the VMAs to be subjected to this method require the contractor to preserve and protect vegetation 30 feet in height or less in the vicinity of residential neighborhoods at the Runway 29 and 23 ends. In all other areas, where it is more efficient to remove smaller trees in the process of removing those over 15 feet in height, the contractor will be directed to do so. In any case, if trees less than 15 feet in height are damaged during the removal of taller trees, they shall also be removed. All native shrubs in these areas are to be preserved and protected to the extent practicable.

All downed timber, logs, snags, debris, and rubbish of any nature shall be removed as part of the initial vegetation removal. No equipment will be allowed within wetland buffers unless the Contractor can demonstrate that no soil disturbance will occur. Work within wetlands and wetland buffers will not be performed until Massport has secured all necessary permits.

All rutting created by removal efforts will be regraded. Any rutting and soil disturbance that may occur on slopes shall be regraded and stabilized immediately by seeding and mulching as per the mitigation measures contained in Chapter 5 of this VMP. Erosion control barriers are used in these areas on an as-needed basis only. Where optimal working conditions occur, soil disturbance can be completely avoided.

Mechanized Felling

Vegetation in areas designated for mechanized felling predominantly have an upper-story height of 60 to 100 feet. Species primarily include Red Maple, Red Oak, and White Pine. Areas designated as mechanized felling areas are located around the airport periphery, where only the tallest vegetation penetrates the protected airspace and soils allow for equipment access. In these areas, only mature trees need to be removed from the site. Staging areas are to be established in upland areas for log loading.

This technique uses a front-mounted felling head operated hydraulically from a remote cab. The vehicle type can be either small or large, and the vehicle can be tracked or rubber tire. Mechanized fellers include three categories: feller-buncher, feller-director, multi-function harvester. Hand felling is proposed in the area of the capped landfill within VMA 13 to avoid any damage to the landfill liner by machinery.

Feller-bunchers allow the operator to cut several stems at one time and use an accumulator to carry cut trees together to a single location where they can be loaded onto trucks for disposal from the project site. Feller-directors can only cut one tree at a time and must bring individual trees to a bunch for removal from the site. Multi-function harvesters allow an operator to fell, delimb, and buck (cut to length) trees from a remote cab.

Erosion control barriers are used on an as-needed basis in these areas. Where rutting occurs, seed and mulch are applied. Jute netting is used where rutting occurs on slopes.

Helicopter Removal

The use of helicopter removal has been specified for those areas where access is limited due to poor soil conditions and/or the presence of other sensitive environmental resources. This removal methodology is suitable for those VMAs where the vegetation removal is limited to large trees and the sapling and shrub layers are to be preserved. This method is proposed primarily as a measure to address potential wetland impacts.

Helicopter removal requires the felling of trees by hand with chain-saws, lopping and reducing limbs in place (optional), and attaching the trunk sections to a cable lowered from a helicopter. The trees are then transported to an established staging area where further processing of each tree is completed. This processing may include chipping of unusable sections and reducing trunks to standard lengths for trucking. Chips and logs are then removed from the staging area by trucks.

Directional felling of trees within wetland areas is practiced to avoid stream channels and dense shrub areas, providing protection to wetland functions and values. Where possible, felling will be directed to the most open area available, since protection and promotion of the shrub layer is an objective within the helicopter removal areas. In VMA 10, directional felling will also be used to avoid impacts to the capped landfill area at the southern end of the VMA.

Top-and-Girdle

The use of the top-and-girdle technique is specified for those mature forested areas where access by machinery is not feasible due to poor soil conditions or other environmental issue; mainly in wetland areas and was substituted for helicopter removal during the 2003 VMP. This technique results in standing dead timber, and thus is not used where pedestrians may occur, or near parking areas or structures.

Top-and-girdle requires access to the trees (on foot) by climbers with chain saws. The height of the trees relative to the airspace elevation must be certain. The individual or small group of trees is then climbed, a specified amount of the limbs dropped to the ground, and then the limbs are further reduced on the ground. Some hand scattering of the limbs is prescribed to avoid too much biomass in one area.

This technique is the most target-specific and sensitive of the primary removal options. It is labor intensive, and results in standing dead timber. The added biomass on the ground did not result in groundcover or shrub impacts in the 2003 clearing project.

E. Selected Secondary Vegetation Management Methods

Vegetation management at public use airports is a multi-task, continuous process which can only be successful if the initial removal plan addresses the long term maintenance issues. Typically, the initial removal of penetrations is completed by a contractor, while the maintenance of selected areas is completed by the airport staff which is normally limited in terms of both number of personnel and budget. The ease of this maintenance task usually determines the

long term viability of the clearing project. It is this maintenance issue which is of primary concern to the airports in general since the protected surfaces must be kept clear of penetrations after the initial removal project.

The VMP for L.G. Hanscom Field involves an initial mechanical removal of the vegetation which is presently penetrating the protected surfaces. Dominant species within both the upland and wetland areas at the airport include many which are capable of rapid re-growth from stumps, stems, and/or root systems. Shrub species are typically not a concern in this regard since their maximum height restricts them from penetrating the protected surfaces in most cases. However, many deciduous tree species routinely exhibit re-sprouting from cut surfaces. These sprouts have the capacity for rapid growth since the full mature root systems remain in the ground providing the necessary ingredients for growth. Additionally, the sprouts are often multi-stemmed, resulting in more penetrations to the surface than the original individual plant, and a higher density of stems to maintain. Some of the species capable of this type of re-growth and which are common at the airport include:

Red Maple	<i>Acer rubrum</i>
Red Oak	<i>Quercus rubra</i>
White Oak	<i>Quercus alba</i>
Black Oak	<i>Quercus velutina</i>
Quaking Aspen	<i>Populus tremula</i>
Cottonwood	<i>Populus deltoides</i>

Secondary management techniques proposed with this project that address the long-term maintenance of the VMAs include:

- Herbicide application
- ~~Prescribed burns~~
- Selective thinning
- Mowing

Table 4-1 provides a listing of the VMAs and the applicable secondary management techniques proposed for each. The following sections provide a discussion of each of the selected secondary management techniques.

E-1 Herbicide Application

This maintenance issue has been a concern for many years in various vegetation management situations including power line rights-of-way, roadsides, and railroad corridors. Chemical control of these situations has developed as the preferred method in terms of the environmental protection, the intensity of the labor involved, durability of the control, longevity of the project, and cost. Since these efforts have been ongoing for many years, research and development of increasingly advantageous chemical controls has been constant, resulting in a variety of safe and beneficial types. Additionally, the research has developed a variety of types of these controls which have differing properties, allowing for the selection of one which is specifically matched for the intended situation. The data which have been accumulated over these many years regarding these modern herbicide types show that the proper use of these chemical methods provides an efficient means of control while protecting the environment. Many of the

products are approved by both federal and state resource protection agencies for use in wetland situations, and even within close proximity to drinking water supplies. Many conservation agencies employ chemical methods for the elimination of invasive species in sensitive wetland areas. Chemical methods are a lower impact, more efficient option than continuous mechanical removal of stems. In general, the use of the chemical control alternative has the following advantages over several mechanical clearings:

- There is an increased longevity of the original vegetation removal since new growth must generate new root systems, as opposed to regrowth utilizing existing mature root systems.
- The frequency of mechanical removal is decreased, thus improving the overall landscape of the site by eliminating stumps, slash, etc.
- Chemical controls are selective, allowing shrubs and groundcover to remain without injury after the completion of the application. There is typically no incidental damage to non-target vegetation.
- Access to the management sites is not an issue when chemical applications are used since a backpack sprayer is the common form of equipment used for the application.
- Maintenance of the areas is significantly decreased thus reducing the overall costs of vegetation management.

Herbicide Regulatory Authority

The use of various chemical methods for long term vegetation management is an acceptable alternative and was thoroughly discussed and reviewed throughout the GEIR for Vegetation Removal process. The selected method of herbicide application and the brand name products to be employed were also included in the GEIR. This method has been reviewed pursuant to the Massachusetts Environmental Policy Act and the Massachusetts Wetlands Protection Act, and is regulated by the Massachusetts Department of Food and Agriculture (MDFA) through a series of regulations. Additional federal regulatory authority which may pertain to the use of the specified chemical controls includes the Occupational Safety and Health Agency and the Federal Insecticide, Fungicide, and Rodenticide Act. Over eight vegetation management plans at public use airports which involved the use of herbicides in buffer zone and wetland situations have been approved by local conservation commissions and the Massachusetts Department of Environmental Protection pursuant to the limited project provisions of the Massachusetts Wetlands Protection Act Regulations. Additionally, the particular herbicide to be used at Hanscom Field is approved for use in wetland situations and near public water supplies (see Appendix C).

In order for an herbicide to be used in a particular situation, it must be registered and approved for that use by the U.S. EPA and the corresponding state agency (Massachusetts Department of Food and Agriculture). Use of herbicides in wetland situations usually requires additional levels of regulation and, in Massachusetts, the Rights of Way Management Regulations (333 CMR 11.00) apply for railroad and utility rights of way. The GEIR recommends these regulations be used as guidance for airport vegetation removal projects. These regulations include measures for storage, mixture, application rates, species selection, applicator training requirements, etc. The preparation of a vegetation management plan prior to the use of the herbicides is a requirement of these regulations. The proposed use of chemical methods will be

in compliance with all state and federal regulations. Applicators will be required to be licensed as per the requirements of 333 CMR 13.00.

Proposed Application Techniques

The application of herbicides can take many forms such as hand spraying of un-cut vegetation, including foliar treatment, application into man-made wounds, or coating of tree stumps after cutting has occurred. Based on an evaluation of the techniques employed at other airports in combination with the target species at L.G. Hanscom Field, foliar treatment was selected as the single method of herbicide application most appropriate for this VMP due to its efficiency and ease of target selection. Discussions with conservation agencies that employ a variety of herbicide application methods assisted in our selection.

Foliar treatments will be conducted at least one growing season after the initial mechanical or hand removal of vegetation from the target areas. This treatment consists of applying a designated amount of spray (as per the manufacturer's recommendations) to the regrowth to cover about 50-60% of the existing foliage using a low pressure sprayer. The application is to an individual sprout, and is not broadcast over a wide area. It is not necessary to wet the entire plant, thus reducing herbicide volumes. The regrowth should be between 2 and 6 feet in height when treated, with a maximum of 10 feet. This height range should be achieved during the growing season following the cutting. Typical spray volumes are 15-25 gallons per acre of the low concentration herbicide/water mixture. Applications will be conducted during the growing season and during calm wind conditions to limit the mortality of non-target species.

Herbicides for use in wetland areas are even more limited since potential impacts due to toxicity, persistence, and mobility are key issues in protecting aquatic organisms and drinking water supplies. The Massachusetts Department of Food and Agriculture has developed a listing of the pesticide components which are not approved for use in wetland areas. The herbicide to be used in this VMP shall be approved for use in wetlands. Review of the material safety data sheet for the selected type reveals very low toxicity for aquatic organisms, a short half-life, and low mobility in soils (Appendix C). Restrictions on the use of the herbicide in wetland areas include the following (as found in 333 CMR 11.00):

- No herbicide shall be applied on or within 10 feet of any standing or flowing water. At L.G. Hanscom Field, the foliar treatment is to be completed annually until the objectives are achieved. For the 2003 clearing project, 4-5 applications were necessary to control re-growth and invasive species. Touch-up applications will be required periodically after the initial intensive control period.
- No herbicide shall be applied within 100 feet of the edge of a vernal pool. These existing and potential pool areas occur in VMAs 2 and 6.

Herbicide Product Information

The target species at the airport include deciduous trees that are capable of heights exceeding 60 feet. Many of the species are quick growing (*Populus* spp.) and are prolific (*Acer* sp.) warranting the additional management beyond the removal stage. As was discussed above, most modern herbicides are specific for groups of similar vegetation, thus the list of target species for a site needs to be compared to the manufacturer's data. For L.G. Hanscom Field,

the list of target species and the need for chemical control in wetlands is adequately addressed by a single type of herbicide: a glyphosate product with several brand names including Accord, Roundup, and Rodeo. Roundup is widely used by the general public and professionals throughout the world. It has an excellent safety record and is approved for use in wetlands by the MDFA (333 CMR 11.00).

It is recommended that a glyphosate herbicide with a surfactant be utilized as a foliar spray where the treatment is required. The application will consist of an approximate 7% solution which also contains a surfactant to improve contact time with the target species. Surfactants act as a detergent which improves coverage of the spray on the leaf surface and a higher mortality of the target species. The surfactant is composed of carbon, hydrogen, and oxygen, and is chemically related to an alcohol. Most surfactants have very low toxicities, and are rapidly broken down in the environment (short half-life) to harmless byproducts (carbon dioxide and water). The solution would be applied at the rate of approximately 20 gallons per acre using a backpack sprayer by a professional who is licensed in accordance with all applicable state and federal regulations. This person will be responsible for the proper mixing, handling, and application of the product.

After the completion of the initial clearing and foliar treatments, some regrowth will remain and tree saplings will become re-established within the management areas. The number of saplings will be initially low; but if no maintenance is practiced, the numbers can be unmanageable within three years after the initial treatments. Without maintenance, there will likely be a need for additional intensive mechanical and chemical management in the future.

It is anticipated that after the third or fourth foliar treatment of each removal area where this technique is prescribed by this VMP, tree saplings will begin to establish themselves within most management areas. Through the use of hand clippers, chain saws, or brush trimmers, the saplings will be selectively removed from wetland areas allowing all shrubs to remain. By protecting the shrub layer and enhancing shrub growth, sunlight will become a limiting factor for sapling establishment, thus reducing the maintenance effort in the wetland management areas. This is also important for the restriction of nuisance vegetation from the management areas. Protection of the shrub layer will restrict the spread of this vegetation to additional areas. Within the upland management areas, the same maintenance can be practiced or, if available, a small brush mower can be used to keep all vegetation down to ground level, promoting herbaceous growth. Through the use of a brush mower, additional land can be maintained at the airport in an efficient manner.

E-2 Prescribed Burning

~~Prescribed burning could be utilized as a supplemental maintenance tool within VMAs 4 and 5. This maintenance method offers various advantages to the airport and natural resources over mechanized maintenance; although, its use is limited to low shrub areas with adequate setbacks from residential areas. The timing of the burn is important in terms of both control of the burn, and protection of wildlife. The burns are set for the spring season, prior to May 1, or shortly thereafter, in order to take advantage of the natural ground moisture during that season (for burn control) and to avoid ground nesting bird species egg dates.~~

The methodology to be used for prescribed burns was developed by Massport and used within VMA 5 in 1998. The compilation of the burn plan involved input from several universities and local and state agencies, and may be used as the basis for future burns when feasible. It includes information on weather conditions as well as a safety/emergency response plan. It is included in Appendix F of this VMP document as a proposed method of implementation.

Prescribed burning is listed in this VMP as a potential maintenance tool, and not as a vegetation removal method, due to the extent of the vegetation growth within the subject VMAs. Mechanical methods must be used initially to reduce the amount of vegetative fuel in the subject VMAs, which is currently excessive compared to the standard. It is proposed to possibly utilize the burns during year 3 of the VMP, which is two growing seasons after the initial mechanical removal. All necessary permits and coordination will be completed during the winter months prior to the spring burn, since the burns are dependent upon local and state permit approvals. If the burns are not feasible, herbicide applications and/or selective thinning will be used to address the re-growth.

E-3 Selective Thinning

Selective thinning refers to the removal of target re-growth using hand clippers or gas operated brush cutters. Since ground disturbance is not an issue when using this technique, it can be completed during any season. The use of selective thinning is restricted by the density of the target vegetation. Where re-growth densities are high, the use of selective thinning becomes labor intensive. For this reason, it is listed in combination with herbicide applications, to be used at the discretion of the airport.

E-4 Mowing

The mowing of herbaceous cover within both wetland and upland areas is listed as both a primary and secondary management technique in this VMP. Where the existing VMA consists of herbaceous species (i.e. VMA 1), mowing is used to maintain the area in its present condition. Where the initial removal method will create an herbaceous cover (i.e. VMAs 7, 8, and 12), mowing will be used as a maintenance tool once the woody species have been eliminated. Mowing can be completed during any season within the upland areas, however the mowing of wetland areas (VMA 7) will require dry or frozen ground conditions.

F. Yearly Operational Plans (YOPs)

Development of Yearly Operational Plans (YOPs) provides strategies for annual scheduling and budgeting of vegetation management activities. The costs associated with the vegetation removal normally require the separation of the removal work into two or more years. Additionally, many maintenance tools require specific time periods and/or weather conditions to be utilized. YOPs are typically specified over a five year period.

The proposed vegetation management plan for areas other than the Hartwell Town Forest involves an initial mechanical and hand removal of obstructions followed by sapling removal and nuisance vegetation control through the following methods: foliar treatment of the regrowth, selective thinning, and/or mowing. It is proposed to complete all of the necessary penetration removal in the first year (during dry or frozen ground conditions sufficient to eliminate wetland

impacts due to the removal of the logs and slash), followed by foliar treatments as shown in Table 4-5. Maintenance of all management areas will be performed during the third year of the plan, and then on an annual basis. By continuously eliminating tree saplings, a dense shrub cover will become established suppressing future sapling growth within the applicable VMAs. Only through yearly maintenance will management areas remain free of obstructions, thus the maintenance is included in this VMP. Typically, lack of maintenance over one year is sufficient to create unmanageable conditions. However, the extent of the maintenance will be significantly reduced by the use of herbicide treatments as part of the VMP.

Table 4-5: *Yearly operational plans for the VMP at Hanscom Field for each of the five years of the plan.*

Year	Actions
1	Removal of all identified penetrating vegetation from the VMAs according to the removal methods proposed in this VMP. Wetland work is restricted to periods of dry or frozen ground conditions. Complete baseline monitoring of the vegetation plots and the invasive species control areas.
2	Initial Foliar Treatment within VMAs 4, 5, 6, 7, and 15, typically completed in mid-to-late summer. Initiate invasive species mitigation in VMAs 4,6, 9, and 13. Complete vegetation and invasive species monitoring reports.
3	Maintenance of all VMAs including second foliar treatment. Invasive species control in applicable VMAs. Complete vegetation and invasive species monitoring reports.
4	Third foliar treatment of all applicable VMAs. Invasive species control in applicable VMAs. Complete vegetation and invasive species monitoring reports.
5+	Maintenance of all VMAs including fourth foliar treatment. Invasive species control in applicable VMAs. Complete final vegetation and invasive species monitoring reports.

As the YOPs for each removal project prepared under this VMP are completed, the need for additional maintenance beyond the final year of the plan will be determined. If additional removal or treatments are needed, they will be included in the next VMP removal project (and the permitting thereof).

G. Discussion of Environmental Effects

The potential effects from the implementation of the VMP at Hanscom Field are primarily restricted to the modification of vegetative cover types within the VMAs. The change in cover may affect wildlife habitat, storm water runoff characteristics, surface water quality, and overall aesthetics. The assessment of the potential environmental effects associated with the vegetation removal projects completed under this VMP will be addressed in a project-specific fashion, within the individual permit applications completed for each removal project. The scope of the assessments should be based on the size and location of each removal project, and the assessment method should be consistent with applicable state and federal environmental regulations. Assessments of individual projects are to be provided in the respective Notices of Intent.

CHAPTER 5: MITIGATION MEASURES

Mitigation measures are proposed to address the environmental constraints discussed in Chapter 3. Additional measures may be included in the individual permit applications completed for each Vegetation Management Plan (VMP) update. The primary goals of the mitigation measures include:

- Remove identified and potential penetrations to the FAA Part 77 and TERPs surfaces at the airport in a safe and orderly manner according to the contract documents, environmental permits, and all applicable state and federal laws and regulations.
- Conduct the vegetation management in a manner that protects sensitive environmental resources, produces a wetland vegetative community that provides important functions and values and requires minimal maintenance.
- Be sensitive to immediate abutters of the airport who may be affected by any change in the vegetative community within the Vegetation Management Areas (VMAs).
- Control the spread of existing nuisance plant species at the airport through a combination of project timing, methodology, and restoration.
- Protect wetland resources from erosion and sedimentation impacts during the initial removal operation and maintain suitable wetland plant communities for wildlife.

The following is a listing of the mitigation measures which will help to achieve the overall goals of the project as listed in Chapter 1, while also addressing the mitigation goals as listed above.

Mechanical Removal Methods and Timing

Selection of the mechanical removal methods and identification of the VMAs that will receive designated treatment is the result of a comprehensive investigation of the vegetative communities and environmental resources that comprise the airport property and available removal alternatives as discussed in Chapter 4. Criteria for the selection included the locations and sensitivity of environmental constraints, and the elevations of the protection zones. The heights of the vegetation to be removed, the height and density of the vegetation to remain, along with the environmental conditions dictate the type of equipment that can be used to remove the obstructing vegetation. In this manner, only that vegetation which penetrates, or threatens to penetrate the protected surfaces will be removed allowing, in most cases, the shrub layer to remain.

The mechanical methods will be used only during periods of dry or frozen ground conditions where the tracked or rubber-tired vehicles will not cause disturbance of the soils. This is the most important mitigation measure proposed since it minimizes or avoids soil disturbance and thus eliminates the threat of sedimentation and significantly reduces the extent of disturbed ground which is favored by invasive species.

The proposed mechanical removal methods also result in a diversification of wildlife habitat; potentially resulting in a cover type that is increasingly rare in the northeast. Many rare avian species are facing a decline in numbers due to the cessation of farming and the gradual succession of open fields to mature woods. The loss of this habitat type to succession and development has left many avian species without nesting and feeding habitat. Many of the estimated habitats of rare species in Massachusetts include such ecosystems. In fact, most airports are included on the estimated habitat maps due to the presence of substantial area of the early successional cover types. Species such as the grasshopper sparrow, upland sandpiper, and short-eared owl are all confirmed rare species that currently inhabit airport properties in Massachusetts due to the presence of open grassland and early successional scrub-shrub habitat.

Removal of debris after the completion of the mechanical removal will be a condition of the contract, unless areas are identified where removal may result in more damage than allowing the cut vegetation to remain, such as in VMA 13 adjacent to the landfill or in top-and-girdle areas. In these cases, the logs may be cut into 24" lengths and allowed to rot in place. The creation of brush piles as habitat is an exception as discussed in this chapter.

Chemical Control Methods

Any Notice of Intent prepared for vegetation management proposing herbicides at L.G. Hanscom Field will include herbicide application guidelines similar to existing utility rights of way regulations as described in Chapter 4. Full compliance with these guidelines is a mandate. Through the full compliance with the guidelines, by following the additional use restrictions, and by using a product which is approved for use within wetlands and has a relatively low toxicity to aquatic organisms, potential impacts to wetlands will be mitigated. On this project, herbicide applications will not occur within 10 feet of any standing water, or within 100 feet of any certified or potential vernal pool.

Erosion Controls

Locations of erosion control barriers and matting are not established on the project plans since it is anticipated that only minimal controls will be required (based on experience with the first phase of VMP implementation at Hanscom Field as well as experiences with other several airport vegetation management projects). Barriers will be required adjacent to those VMAs where grubbing is proposed including VMAs 8 and 12. It will be a requirement that the contractor stockpile a minimum of 300 feet of erosion control fence on the property, and 1,000 square feet of jute mesh in case of unforeseen soil disturbance within other VMAs. The engineer and/or environmental monitor shall have the authority to direct the contractor to install any and all erosion controls within both wetland and upland areas which he/she deems necessary to protect wetland areas from sedimentation impacts. The environmental monitor will ensure that all necessary precautions are employed to avoid soil disturbance that could otherwise result in the spread of invasive plant species which presently inhabit the airport and surrounding areas. Much of the proposed work will occur during the winter months where snow and/or frost conditions do not typically allow for the proper installation of these erosion control devices, or it may be determined that the installation will not result in any additional protection. Since it is not possible to foresee all conditions under which the work will be completed, the engineer and/or environmental monitor will have the authority to determine the required controls.

Seeding Specifications

Areas of ground disturbance will be further protected through the use of seed mixes that will establish a reasonably quick cover (thus reducing the ground available for invasive species) but will not out-compete the species already present in the areas. The contractor shall have available 80 pounds of upland seed and 40 pounds of wetland seed, and sufficient mulch to cover 10,000 square feet (30 bales). Seed and mulch shall be applied at the direction of the engineer and/or environmental monitor. The seed mixtures and application rates for both upland and wetland situations are provided below.

Upland Seed Mixture:	45%	Red Fescue (<i>Festuca rubra</i>)
	35%	Annual Ryegrass (<i>Lolium multiflorum</i>)
	13%	Virginia Wild Ryegrass (<i>Elymus virginicus</i>)
	5%	Partridge Pea (<i>Chamaecrista fasciculata</i>)
	2%	Switchgrass (<i>Panicum virgatum</i>)
		40 lbs/Acre
Wetland Seed Mixture:	50%	Creeping Bentgrass (<i>Agrostis stolonifera</i>)
	20%	Fowl Bluegrass (<i>Poa palustris</i>)
	15%	Deertongue Grass (<i>Panicum clandestinum</i>)
	10%	Switchgrass (<i>Panicum virgatum</i>)
	5%	Annual Ryegrass (<i>Lolium multiflorum</i>)
		40 lbs/Acre

Each seeded area will receive additional protection through the use of a mulch to protect the seed during the winter months and to protect against dessication during the summer months. Mulch may consist of the following:

Mulch:	Hay or Straw, air dried and free of undesirable seeds.
	Wood fiber, cellulose with green dye (for hydroseed option)
	120 lbs/1000 SF (3 bales)

The upland seed mix shall be used within VMAs 8 and 12 where grubbing is proposed. In both areas, the seed and mulch shall be applied using a hydroseed application, where wood fiber mulch is included in the mixture. Where incidental soil disturbance occurs during the removal operation, hand application may be substituted for hydroseeding.

Staging Areas

Staging areas (the locations to be used for log/debris storage) are specified only for those areas where the proximity to wetland boundaries, property lines, and/or steep slopes make the pre-designation of such areas necessary to protect these resources. The contractor may establish as many other staging areas as necessary to complete the work, but only upon the approval of the engineer and/or environmental monitor. It is likely that permit applications for each vegetation removal plan prepared under this VMP will require that staging areas be specified on the permit application plans. Such areas are likely to result in some upland soil disturbance, thus all staging areas are to receive upland seed and mulch when construction is complete.

Debris is to be removed from the staging areas after completion of each section of the work, as per the removal specifications for each mechanical removal method discussed in Chapter 4.

~~The helicopter removal areas (VMAs 3 and 10) will require one or more staging areas within upland areas close to the VMA but in coordination with the air traffic control tower. The locations of the staging areas may vary depending upon the weather conditions during the days of operation, thus pre-determination of the sites is not practical.~~

Limited Access Areas

One of the environmental constraints identified on the project site was restrictive slopes, mainly associated with the two stream channels on the airport property. Additionally, soil conditions and rare species habitat also affect the areas to be used for access. Designated access is identified only for those areas where unrestricted access may affect the goals of this VMP. In other areas, access may be gained by a variety of routes, per the concurrence with the engineer and/or environmental monitor. All access and movement by vehicles associated with this VMP must adhere to airport safety policies and regulations. Access routes referenced herein do not relieve the contractor from meeting all restrictions and regulations regarding movement in and around the airport.

Table 5-1 provides information necessary to complete the vegetation management while avoiding sensitive areas.

Table 5-1: *Listing of sensitive areas at L.G. Hanscom Field which require specified staging areas and access routes due to soil, topography, rare species, and/or wetland issues.*

VMA Identifier	Comments on Access
3 and 10	Soil conditions unable to support heavy machinery. Directional felling and cabling of logs will be required for removal. Top-and-girdle is specified for the removal of interior obstructions from these VMAs.
15 and 16	Preserve a vegetated screen between the airport and adjacent residences.
14	Locate and mark groundwater monitoring wells, and avoid damage to the wells.
2 and 6	Vernal pool areas. No machinery allowed within 50 feet of pool banks. No herbicide application within 100 feet of pool banks. Pools and the setbacks are to be marked with flagging prior to vegetation removal.
4 and 9	Steep and wide stream channel with unstable banks will not allow for crossing between the upland VMAs on either side of the channel. Hand clearing will be required for the wetland VMA within the stream corridor. No crossing of the channel will be allowed.
13 and 10/11	Existing capped landfills to be avoided by machinery. Directional felling shall be practiced adjacent to the landfills to avoid damage to the liners.
6	Additional precautions shall be taken to preserve the shrub and sapling layer to continue functioning as a screen between the airport and adjacent residences.

Wildlife Habitat Improvements

FAA Advisory Circular 150/5200-33, *Hazardous Wildlife Attractants on or Near Airports*, states that "caution should be exercised to ensure that land use practices on or near airports do not enhance the attractiveness of the area to hazardous wildlife."

Within the criteria set forth within this advisory circular, limited numbers of isolated brush piles and standing dead timber (snags) will be constructed on the airport property to sustain existing wildlife habitat during the each removal operation. Brush piles shall be constructed of fresh cut branches and trunks that do not exceed six inches in diameter and are not less than six feet in length. Each pile shall measure between four and eight feet in height (lightly compacted), and have a surface area of between 300 and 600 square feet. Severe compaction of the piles shall be avoided, since the creation of void space is a goal of this habitat improvement. Piles shall be placed in locations approved by the Environmental Monitor at the densities indicated in Table 5-2 for the initial cutting plan. Snags shall be created out of live trees that are greater than 10 inches in diameter. Individual trees shall be selected by the environmental monitor at the density indicated in Table 5-2 for each removal plan that involves the applicable VMAs. The selected trees shall be cut a minimum of 15 feet off of the ground so that a standing trunk remains. The base of the tree shall be girdled to ensure tree mortality. Existing snags encountered during removal operations shall be preserved and protected if they are not obstructions to existing airspace. Additional snags/piles can be specified for future management operations.

Table 5-2: *Brush pile and snag creation within specified VMAs for each removal project where the VMA is involved.*

VMA	No. of Snags	No. of Brush Piles
2	12	8
3	8	n/a
13	8	3
14	12	3
16	4	2

Environmental Monitor

A qualified environmental monitor who is proficient in the state wetland, herbicide, and forest cutting regulations, and who has a working knowledge of this VMP shall supervise the completion of the mechanical removal portion of the yearly operational plans. The minimum requirements for the monitor include a bachelor's degree in environmental science or related field, a minimum of two years experience with erosion control/wetland monitoring of construction projects, and a minimum of five years experience with the Massachusetts Wetlands Protection Act Regulations. This monitor shall be aware of the locations of all sensitive areas, including wetland boundaries and the limits of the habitat of rare species. The environmental monitor shall direct the contractor to apply certain mitigation measures on an as-needed basis, including the installation of erosion controls and the seeding of altered areas. The environmental monitor shall be consulted on access routes and staging areas, and shall be the environmental contact person between the airport, community, and the contractor.

Vegetation Plot Monitoring

Massport will continue a program of vegetation monitoring of the existing plots within the VMAs throughout this VMP update. Plot locations were determined during the 2003 VMP and consist of the following:

- Plot centers permanently marked with an iron rod pounded into the ground and marked with highly visible paint. The plot locations have been survey-located and included on a plan of the airport. Each plot has been marked on the plan with latitude/longitude and Massachusetts state plane coordinates. The plan shall be used as a figure in each monitoring report.

Baseline data of the existing vegetation within the monitoring plot shall be collected during the growing season and prior to any project disturbance of the subject VMA. Photographs of the shrub/sapling layer, and a close-up of the groundcover layer shall be collected for each plot. Monitoring data shall be collected using techniques specified by the Department of Environmental Protection in determining wetland plant species composition and abundance. This technique includes an evaluation of the following vegetative strata:

Canopy Layer	Basal area, in square inches, of all tree species within a 30-foot radius circle
Lianas	Stem count of all climbing woody vines within a 30-foot radius circle
Saplings	Percent cover of all saplings greater than one inch diameter and 30 feet in height in leaf-on condition within a 15-foot radius circle
Shrubs	Percent cover of all shrubs greater than three feet in height in leaf-on condition within a 15-foot radius circle
Groundcover	Percent cover of all woody/herbaceous groundcover species within a 5-foot radius circle.

- An annual monitoring report shall be completed for the monitoring plots for an additional five years. Vegetation monitoring shall be completed each year during the growing season, and at approximately the same time of year as the baseline data collection. The reports shall contain an analysis of the vegetation in the plots using the above described methodology, a comparison of the percent coverage and species composition of the plots to the baseline data, a computation of percent wetland species coverage, a discussion of the increase/decrease of invasive species coverage, and a discussion of the re-vegetation of the plot relative to the performance standards of the Massachusetts Wetlands Protection Act. Photographs for each plot shall be collected for each annual report, and they shall be taken from the same location and angle as the photos taken for the baseline data.
- As part of each annual report, the measures taken for nuisance species elimination from the nuisance species control areas (described below) shall be included.

Nuisance Vegetation

Invasive vegetative species exist at the airport and have been identified as an environmental constraint in this VMP. In most wetland areas on the site, European Buckthorn is a dominant species within the shrub layer. Furthermore, Purple Loosestrife is common within the scrub-shrub and emergent wetlands on the site, particularly where beaver activity has resulted in increased light penetration along Elm Brook and the Shawsheen River. Since these species occur on and adjacent to the airport property in high densities, eradication of the species is not an objective of the VMP. Control of the spread of these species will be practiced. The following measures will be taken to control the spread of nuisance vegetation:

- Erosion control measures identified in this chapter shall be followed immediately upon the identification of disturbed soils. Seed and mulch specifications are particularly important since the establishment of a dense cover of other vegetation is the principle deterrent to the spread of these species. Staging areas and the clear/grub VMAs (8 and 12) are the largest potential areas of disturbed soil, thus the mitigation focus in these areas will be the quick establishment of turf.
- Where opportunities exist within the mowing and cut-and-chip VMAs, European Buckthorn will be targeted for removal if other shrub species are present in the community. The environmental monitor will identify mono-cultures of the nuisance species that can be cut along with the sapling removal. This will allow native shrub species an opportunity to colonize the area.

Four nuisance species control areas were established as part of the 2003 VMP. These included portions of VMAs 4, 6, 9, 10 and 13. Additional control areas may be established as a part of future VMP updates. Protection of native shrubs during the invasive species control is an objective of this mitigation measure. The control includes the identification of the control area limits followed by the systematic identification and elimination of nuisance shrub species using a combination of selective thinning and herbicide applications that favor the growth and spread of existing native shrubs. Target species in the sites include European Buckthorn, Japanese Barberry, and European Honeysuckle. Nuisance groundcover species are not known to occur in the selected areas, however, if present, the following species will also be targeted: Purple Loosestrife, Common Reed, and Oriental Bittersweet. The process of control includes the mechanical and/or hand removal of the nuisance species from the limits of the control areas during the mechanical removal phase of the project. During the following four yearly operational plans of a management period, hand thinning or a combination of thinning and herbicide treatments will be used for the elimination of the nuisance vegetation. Herbicide applications, while effective, cannot be used in all of the control areas due to open water restrictions on herbicide applications.

As part of this mitigation measure, the success of the control sites shall be documented on an annual basis, with the results submitted along with the vegetation monitoring reports described above. Baseline data of each control area shall be collected prior to any control measures including an analysis of the shrub layer composition and density using the vegetative data collection techniques for the shrub layer described above. A sufficient number of baseline

photographs shall be taken of each control area during the growing season which, in combination with the shrub plot data, can be used to determine the success of the control. Annual data collection and photographs shall be collected after each year's control efforts have been completed. Each control area will require five years of monitoring.

Vernal Pool Protection

Vernal pools within VMAs 2 and 6 shall be marked in the following manner prior to the vegetation removal projects within the subject VMAs:

- The pool edge shall be marked every five feet with brightly colored surveyor's flagging (four pools).
- The 50-foot perimeter from the pool edge shall be marked with "caution" tape during mechanical removal operations.
- The 100-foot perimeter from the pool edge shall be marked with "caution" tape during herbicide applications within the subject VMAs.
- All markings will be removed after completion of the work.

The following conditions are part of this VMP and apply to working within VMAs 2 and 6:

- No mechanical removal of vegetation shall occur within 50 feet of the vernal pool edge as marked by "caution" tape.
- No herbicide applications shall be made closer than 100 feet from the edge of the pool, and shall be completed within vernal pool habitat between July 1 and September 1.
- Directional felling of vegetation shall be practiced within 50 feet of the vernal pools. Trees shall be felled away from the established 50-foot perimeter.
- Erosion control barriers within 200 feet of the vernal pools shall be installed in a staggered format so that gaps exist within the barrier to allow for the passage of wildlife, but continue to provide effective stormwater filtering from disturbed areas. Barriers shall not remain in place for more than four months.

Appendix G Cultural Resources

Appendix G

Cultural and Historical Resources

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Table G-1 Historic Architectural Resources located at Traffic Study Intersections, 2012

Intersection Number	Town	Intersection	Historic Resources Name (Designation)
1	Lexington	Route 4/225 (Great Rd)/Hartwell Ave	None
2	Lexington	Route 2A (Marrett Rd)/Mass Ave	None
3	Lexington	Route 2A (Mass Ave)/Old Mass Ave	Minute Man National Historical Park (MMNHP) (NHL, NR)
4	Lexington	Route 2A (Mass Ave)/Airport Rd (Marrett St)	Minute Man National Historical Park (NHL, NR)
5	Lincoln	Hanscom Drive/Old Bedford Rd	None
6	Lincoln	Route 2A (North Great Rd)/Hanscom Dr	Minute Man National Historical Park (NHL, NR) LIN.157 Giurleo House (MMNHP) LIN.158 Giurleo House Garage (MMNHP)
7	Lincoln	Route 2A (North Great Rd)/Bedford Rd	Minute Man National Historical Park (NHL, NR)
8	Lincoln/Concord	Route 2A (Lexington Rd)/Cambridge Turnpike Cutoff /Brooks Rd	Minute Man National Historical Park (NHL, NR) CON.358 Samuel Brooks House (MMNHP)
9	Concord	Lexington Rd/Old Bedford Rd	Minute Man National Historical Park (NHL, NR) CON-BL Lower Old Bedford Rd/Virginia Rd Area (MACRIS) CON.175 Deacon Sampson Mason-Terrence McHugh House (MMNHP/CON-BL) CON.349 Daniel Taylor House (MMNHP/CON-BL) CON.351 Burke House (MMNHP/CON-BL) CON.1812 Burke Garage (MMNHP/CON-BL)
10	Concord	Old Bedford Rd/Virginia Rd	CON-BL Lower Old Bedford Rd/Virginia Rd Area (MACRIS) CON.1069 Patrick Dalton House (CON-BL)
11	Concord	Old Bedford Rd/Route 62 (continues as Old Bedford Rd)	CON-BN Old Bedford Road Area II (MACRIS) CON-BO Bedford Street Area II (MACRIS) CON.1090 759 Bedford Street House (CON-BO)
12	Bedford	Route 62 (Concord Rd)/Hartwell Rd	BED.H Concord Road Area (MACRIS) BED.344 247-249 Concord Road House (MACRIS)
13	Bedford	South Rd/Hartwell Rd	None

Note 1. MMNHP – Minute Man National Historical Park; NHL – National Historic Landmark, NR – National Register of Historic Places; LHD – Local Historic District

Table G-1 *Historic Architectural Resources located at Traffic Study Intersections (continued)*

Intersection Number	Town	Intersection	Historic Resources Name (Designation)
14	Bedford	Routes 4/225/62	BED.A Bedford Historic District (LHD) BED.C Old Bedford Center Historic District (NR) BED.117 E.W. Stearns House (BED.A/BED.C) BED.119 The Red Barn (BED.A/BED.C) BED.29 Elijah Stearns-Squire Stearns House (BED.A/BED.C) BED.40 Amos Cutler House (BED.A/BED.C)
15	Bedford	Great Rd (4/225)/South Rd/Springs Rd	BED.A Bedford Historic District (LHD) BED.C Old Bedford Center Historic District (NR) BED.E Fletcher Road Area (MACRIS) BED.G Bedford Municipal Area (MACRIS) BED.227 78-88 Great Road Commercial Block (BED.A/BED.C/BED.E) BED.23 Bedford Old Town Hall (BED.A/BED.C/BED.G) BED.24 First Parish Church (BED.A/BED.C) BED.34 Mary Harwell-Dr. Edward Hamblen House (BED.A/BED.C/BED.E) BED.67 5 Springs Rd House (BED.A/BED.C) BED.68 94 Great Rd House (BED.A/BED.C) BED.92 Morgan Stores (BED.A/BED.C) BED.93 20 South Rd (BED.A/BED.C) BED.800 Old Burying Ground (BED.A/BED.C)
16	Bedford	South Rd/Railroad Ave/Loomis St	BED.F South Rd.-Depot Square Area (MACRIS) BED.V Bedford Depot Park Historic District (NR) BED.180 Billerica and Bedford Railroad Engine House (BED.F/BED.V) BED.279 Hodgdon Brothers Livery Stable (BED.F) BED.309 Blake Double House (BED.F) BED.310 R.W. Edwards-Wallace A. Calef House (BED.F) BED.311 Brown and Cox Store (BED.F)

Note 1. MMNH P – Minute Man National Historical Park; NHL – National Historic Landmark, NR – National Register of Historic Places; LHD – Local Historic District

All Historic Resources listed in the National and State Registers, and in the Inventory and MACRIS in Bedford, reconnaissance survey area (projected 2030 55 dB DNL high growth noise contour or within 200 feet from a traffic study area intersection), 2012.

MHC Number	Historic Area/District ¹	Street Address	Historic Property ²	Date	National Register /State Register Status ³	55 dB DNL Contour ⁴			Intersection ⁵
						2012	2020	2030	
Bedford									
BED.V	Bedford Depot Park Historic District [NB-5]	80 Loomis St, 120 South Rd	N/A	Multiple	NR				TSA 16: Loomis Street & Railroad Avenue & South Road
BED.A	Bedford Historic District [NB-1]	Great Rd	N/A	Multiple	LHD/SR				TSA 14: Route 4/225 & Route 62 TSA 15: South Road & Great Road
BED.G	Bedford Municipal Area	Bedford Center	N/A	Multiple					TSA 15: South Road & Great Road
BED.H	Concord Road Area	Concord Rd	N/A	Multiple		P	P	P	TSA 12: Hartwell Road & Route 62
BED.E	Fletcher Road Area	Fitchdale Ave, Fletcher Rd, Hancock St, Springs Rd	N/A	Multiple					TSA 15: South Road & Great Road
BED.C	Old Bedford Center Historic District [NB-2]	Great Rd, North Rd, Spring Rd, Hillside Ave, Elm St, Maple St, South Rd	N/A	Multiple	NR				TSA 14: Route 4/225 & Route 62 TSA 15: South Road & Great Road
BED.F	South Road – Depot Square Area	South Rd	N/A	Multiple					TSA 16: Loomis Street & Railroad Avenue & South Road
BED.117	BED.A Bedford Historic District BED.C Old Bedford Center Historic District	2 Concord Rd	E. W. Stearns House	1820	LHD/SR NR				TSA 14: Route 4/225 & Route 62
BED.119	BED.A Bedford Historic District BED.C Old Bedford Center Historic District	5 Concord Rd	The Red Barn	1780	LHD/SR NR				TSA 14: Route 4/225 & Route 62
BED.359	BED.H Concord Road Area	435 Concord Rd	N/A	1947		✓	✓	✓	
BED.1	BED.H Concord Road Area	445 Concord Rd	Richard Wheeler House	1695		✓	✓	✓	
BED.39	BED.A Bedford Historic District BED.C Old Bedford Center Historic District	1 Great Rd	David Rice House	1810	LHD/SR NR				TSA 14: Route 4/225 & Route 62
BED.29	BED.A Bedford Historic District BED.C Old Bedford Center Historic District	4 Great Rd	Elijah Stearn - Squire Stearns House	1810	LHD/SR NR				TSA 14: Route 4/225 & Route 62

MHC Number	Historic Area/District ¹	Street Address	Historic Property ²	Date	National Register /State Register Status ³	55 dB DNL Contour ⁴			Intersection ⁵
						2012	2020	2030	
BED.40	BED.A Bedford Historic District BED.C Old Bedford Center Historic District	5 Great Rd	Amos Cutler House	1835	LHD/SR NR				TSA 14: Route 4/225 & Route 62
BED.24	BED.A Bedford Historic District BED.C Old Bedford Center Historic District	75 Great Rd	First Parish Church	1817	LHD/SR NR				TSA 15: South Road & Great Road
BED.227	BED.A Bedford Historic District BED.C Old Bedford Center Historic District BED.E Fletcher Road Area	78-88 Great Rd	78-88 Great Road Commercial Block	1925	LHD/SR NR				TSA 15: South Road & Great Road
BED.34	BED.A Bedford Historic District BED.C Old Bedford Center Historic District BED.E Fletcher Road Area	90 Great Rd	Mary Hartwell - Dr. Edward E. Hamblen House	1850	LHD/SR NR				TSA 15: South Road & Great Road
BED.92	BED.A Bedford Historic District BED.C Old Bedford Center Historic District	93 Great Rd	Morgan Stores	1950	LHD/SR NR				TSA 15: South Road & Great Road
BED.68	BED.A Bedford Historic District BED.C Old Bedford Center Historic District	94 Great Rd	N/A	1956	LHD/SR NR				TSA 15: South Road & Great Road
BED.927	N/A	Hartwell Rd	Hartwell Town Forest	1940				✓	
BED.928	N/A	Hartwell Rd	Hartwell Town Forest Horse Trough Memorial	1820				✓	
BED.279	BED.F South Road - Depot Square Area	1-5 Railroad Ave	Hodgdon Brothers Livery Stable	1910					TSA 16: Loomis Street & Railroad Avenue & South Road
BED.23	BED.A Bedford Historic District BED.C Old Bedford Center Historic District BED.G Bedford Municipal Area	16 South Rd	Bedford Old Town Hall [NB 4]	1856	LHD/SR NR				TSA 15: South Road & Great Road
BED.93	BED.A Bedford Historic District BED.C Old Bedford Center Historic District	20 South Rd	N/A	1875	LHD/SR NR				TSA 15: South Road & Great Road
BED.309	BED.F South Road - Depot Square Area	103-105 South Rd	Blake Double House	1880					TSA 16: Loomis Street & Railroad Avenue & South Road
BED.310	BED.F South Road - Depot Square Area	106 South Rd	R. W. Edwards - Wallace A. Calef House	1859					TSA 16: Loomis Street & Railroad Avenue & South Road
BED.311	BED.F South Road - Depot Square	111 South Rd	Brown and Cox	1900					TSA 16: Loomis Street &

MHC Number	Historic Area/District ¹	Street Address	Historic Property ²	Date	National Register /State Register Status ³	55 dB DNL Contour ⁴			Intersection ⁵
						2012	2020	2030	
	Area		Store						Railroad Avenue & South Road
BED.180	BED.F South Road - Depot Square Area BED.V Bedford Depot Park Historic District	120 South Rd	Billerica and Bedford Railroad Engine House	1877	NR				TSA 16: Loomis Street & Railroad Avenue & South Road
BED.184	N/A	330 South Rd	Clark Farm	1905		✓	✓	✓	
BED.492	N/A	330 South Rd	Clark Farm Barn	ca. 1905		✓	✓	✓	
BED.493	N/A	330 South Rd	Clark Farm- Out Building	ca. 1905		✓	✓	✓	
BED.494	N/A	330 South Rd	Clark Farm- Out Building	ca. 1905		✓	✓	✓	
BED.495	N/A	330 South Rd	Clark Farm- Out Building	ca. 1905		✓	✓	✓	
BED.185	N/A	345 South Rd	Peter Kelley House	1855		✓	✓	✓	
BED.444	BED.O South Road - Tilden Street Area	394 South Rd	N/A	1930		✓	✓	✓	
BED.445	BED.O South Road - Tilden Street Area	398 South Rd	N/A	1930		✓	✓	✓	
BED.446	BED.O South Road - Tilden Street Area	5 Tilden St		1930		✓	✓	✓	
BED.67	BED.A Bedford Historic District BED.C Old Bedford Center Historic District	5 Springs Rd	N/A	1880	LHD/SR NR				TSA 15: South Road & Great Road
BED.800	BED.A Bedford Historic District BED.C Old Bedford Center Historic District	7 Springs Rd	Old Burying Ground [NB-3]	1729	LHD/SR NR				TSA 15: South Road & Great Road

- Notes**
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 3. National Register of Historic Places (NR), State Register of Historic Places (LHD or SR), National Historic Landmark (NHL).
 4. Area/property is partially (P) or completely (✓) within the 2012, 2020, or 2030 55 dB DNL contours. All historic resources listed are outside the 2012, 2020, and 2030 65 dB DNL contours.
 5. Intersection that is located within 200 feet from historic district, area, or property.

G-3

All Historic Resources listed in the National and State Registers, and in the Inventory and MACRIS in Concord, reconnaissance survey area (projected 2030 55 dB DNL high growth noise contour or within 200 feet from a traffic study area intersection), 2012.

MHC Number	Historic Area/District ¹	Street Address	Historic Property ²	Date	National Register /State Register Status ³	55 dB DNL Contour ⁴			Intersection ⁵
						2012	2020	2030	
CON.BO	Bedford Street Area II	Bedford St	N/A	Multiple		✓	✓	✓	TSA 11: Old Bedford Road & Route 62
CON.BK	Lexington Road – Shadyside Avenue Area	Lexington Rd, Shadyside Ave	N/A	Multiple		P	P	P	
CON.BL	Lower Old Bedford – Virginia Roads Area	Old Bedford Rd, Virginia Rd	N/A	Multiple		P	P	P	TSA 9: Old Bedford Road & Lexington Road (Route 2A) TSA 10: Old Bedford Road & Virginia Road
CON.C	Minute Man National Historical Park	Route 2A	N/A	Multiple	NR/SR NHL				TSA 8:Route 2A (Lexington Rd)/Cambridge Turnpike Cutoff/Brooks Rd) TSA 9: Old Bedford Road & Lexington Road (Route 2A)
CON.EC	Minute Man National Historical Park	Route 2A	N/A	Multiple	NR NHL				TSA 8:Route 2A (Lexington Rd)/Cambridge Turnpike Cutoff/Brooks Rd) TSA 9: Old Bedford Road & Lexington Road (Route 2A)
CON.BM	Old Bedford Road Area	Old Bedford Rd	N/A	Multiple		✓	✓	✓	
CON.BN	Old Bedford Road Area II	Old Bedford Rd	N/A	Multiple		✓	✓	✓	TSA 11: Old Bedford Road & Route 62
CON.183		587 Bedford St	Patrick McGrath House	1875				✓	
CON.1081	CON.BO Bedford Street Area II	643 Bedford St	N/A	1875				✓	
CON.1082	CON.BO Bedford Street Area II	649 Bedford St	N/A	1875				✓	
CON.1083	CON.BO Bedford Street Area II	668 Bedford St	N/A	1895				✓	
CON.1085	CON.BO Bedford Street Area II	689 Bedford St	N/A	1930				✓	
CON.1086	CON.BO Bedford Street Area II	701 Bedford St	N/A	1920				✓	
CON.1088	CON.BO Bedford Street Area II	715 Bedford St	N/A	1880				✓	

MHC Number	Historic Area/District ¹	Street Address	Historic Property ²	Date	National Register /State Register Status ³	55 dB DNL Contour ⁴			Intersection ⁵
						2012	2020	2030	
CON.1089	CON.BO Bedford Street Area II	737 Bedford St	N/A	1870				✓	
CON.1090	CON.BO Bedford Street Area II	759 Bedford St	N/A	1920				✓	TSA 11: Old Bedford Road & Route 62
CON.175	CON.DS American Mile Historic District	645 Lexington Rd	Dea. Sampson Mason - Terrence McHugh House	1850	LHD/SR NR NHL				TSA 9: Old Bedford Road & Lexington Road (Route 2A)
CON.349	CON.C/CON.EC Minute Man National Historical Park CON.DS American Mile Historic District	663 Lexington Rd	Daniel Taylor House	1804	LHD/SR NR NHL				TSA 9: Old Bedford Road & Lexington Road (Route 2A)
CON.9020	CON.C/CON.EC Minute Man National Historical Park CON.DS American Mile Historic District	663 Lexington Rd	Daniel Taylor Retaining Wall	1810	LHD/SR NR NHL				TSA 9: Old Bedford Road & Lexington Road (Route 2A)
CON.358	CON.C/CON.EC Minute Man National Historical Park	1175 Lexington Rd	Samuel Brooks House	1733	NR NHL				TSA 8: Route 2A (Lexington Rd)/Cambridge Turnpike Cutoff/Brooks Rd
CON.930	N/A	Old Bedford Rd	Concord - Bedford Boundary Marker	1903		✓	✓	✓	
CON.1067	CON.BL Lower Old Bedford - Virginia Roads Area	219 Old Bedford Rd	Terrence Magurn House	1900				✓	
CON.1068	CON.BL Lower Old Bedford - Virginia Roads Area	250 Old Bedford Rd	Frank Peterson House	1910				✓	
CON.1069	CON.BL Lower Old Bedford - Virginia Roads Area	275-277 Old Bedford Rd	Patrick Dalton House	1880				✓	TSA 10: Old Bedford Road & Virginia Road
CON.1070	CON.BL Lower Old Bedford - Virginia Roads Area	389 Old Bedford Rd	Daniel McManus House	1905		✓	✓	✓	
CON.179	N/A	430 Old Bedford Rd	Waldo Flint House	1890		✓	✓	✓	
CON.180	N/A	472-474 Old Bedford Rd	Benoni and Thomas Fox House	1711		✓	✓	✓	
CON.181	N/A	505 Old Bedford Rd	Samuel Fox House	1702		✓	✓	✓	
CON.1077	CON.BN Old Bedford Road Area II	527 Old Bedford Rd	N/A	1915		✓	✓	✓	
CON.1078	CON.BN Old Bedford Road Area II	537 Old Bedford Rd	N/A	1915		✓	✓	✓	
CON.1079	CON.BN Old Bedford Road Area II	547 Old Bedford Rd	Theodore Barry House	1870		✓	✓	✓	
CON.182		550 Old Bedford Rd	Enos Fox House	1770		✓	✓	✓	

MHC Number	Historic Area/District ¹	Street Address	Historic Property ²	Date	National Register /State Register Status ³	55 dB DNL Contour ⁴			Intersection ⁵
						2012	2020	2030	
CON.1080	CON.BN Old Bedford Road Area II	595 Old Bedford Rd	Theodore Barry House	1900		✓	✓	✓	
CON.1073	CON.BM Old Bedford Road Area	643 Old Bedford Rd	N/A	1920		✓	✓	✓	
CON.1074	CON.BM Old Bedford Road Area	654 Old Bedford Rd	Sennott House	1875		✓	✓	✓	
CON.1075	CON.BM Old Bedford Road Area	667 Old Bedford Rd	N/A	1920		✓	✓	✓	
CON.1071	CON.BL Lower Old Bedford - Virginia Roads Area	74 Virginia Rd	N/A	1925		✓	✓	✓	
CON.1072	CON.BL Lower Old Bedford - Virginia Roads Area	88 Virginia Rd	J. W. Kenney House	1925		✓	✓	✓	
CON.176	N/A	215-217 Virginia Rd	William Tibbets House - Thoreau Farm	1878		✓	✓	✓	
CON.177	N/A	341 Virginia Rd	Dea. John Wheeler - Capt. Jonas Minot Farmhouse [NC-18]	1730	NR	✓	✓	✓	
CON.178	N/A	477 Virginia Rd	Wheeler - Merriam House [NC-19]	1692	NR	✓	✓	✓	

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 3. National Register of Historic Places (NR), State Register of Historic Places (LHD or SR), National Historic Landmark (NHL).
 4. Area/property is partially (P) or completely (✓) within the 2012, 2020, or 2030 55 dB DNL contours. All historic resources listed are outside the 2012, 2020, and 2030 65 dB DNL contours.
 5. Intersection that is located within 200 feet from historic district, area, or property.

G-4

All Historic Resources listed in the National and State Registers, and in the Inventory and MACRIS in Lexington, reconnaissance survey area (projected 2030 55 dB DNL high growth noise contour or within 200 feet from a traffic study area intersection), 2012.

MHC Number	Historic Area/District ¹	Street Address	Historic Property ²	Date	National Register /State Register Status ³	55 dB DNL Contour ⁴			Intersection ⁵
						2012	2020	2030	
LEX.AJ	Lexington Heights - Meagherville	Avon St, Center St, Earl St, Garfield St, Myrtle St, Reed St, Valley Rd	N/A	Multiple		✓	✓	✓	
LEX.913	N/A	Route 128	Boston and Maine Railroad Bridge over Route 128	1961		✓	✓	✓	
LEX.789	LEX.AJ Lexington Heights - Meagherville	12 Avon St	N/A	1906		✓	✓	✓	
LEX.776	N/A	297 Bedford St	Nathan Reed - James Parker House	1835				✓	
LEX.777	N/A	297 Bedford St	Reed-Parker House Out Building	ca. 1835				✓	
LEX.1028	N/A	315 Bedford St	Basil Hawkins House	1924				✓	
LEX.778	N/A	330 Bedford St	Capt. Christopher Reed House #1	1818				✓	
LEX.413	N/A	331 Bedford St	Simonds Tavern [NLX-1]	1795	NR			✓	
LEX.779	N/A	342 Bedford St	Christopher Reed House #2	1825				✓	
LEX.780	N/A	342 Bedford St	Christopher Reed Barn	ca. 1825				✓	
LEX.790	LEX.AJ Lexington Heights - Meagherville	33 Center St	N/A	1906				✓	
LEX.1047	N/A	7 Dexter Rd	Albert W. Emmons House	1926				✓	
LEX.1061	N/A	46 Harding Rd	John Andersen House	1925				✓	
LEX.1062	N/A	46 Harding Rd	John Andersen Garage	1931				✓	
LEX.785	LEX.AJ Lexington Heights - Meagherville	153 Reed St	N/A	1906			✓	✓	

MHC Number	Historic Area/District ¹	Street Address	Historic Property ²	Date	National Register /State Register Status ³	55 dB DNL Contour ⁴			Intersection ⁵
						2012	2020	2030	
LEX.786	LEX.AJ Lexington Heights - Meagherville	159 Reed St	N/A	1906		✓	✓	✓	
LEX.1012	LEX.AJ Lexington Heights - Meagherville	48 Valley Rd	N/A	1906		✓	✓	✓	
LEX.1013	LEX.AJ Lexington Heights - Meagherville	62 Valley Rd	N/A	1906		✓	✓	✓	
LEX.1014	LEX.AJ Lexington Heights - Meagherville	67 Valley Rd	N/A	1906		✓	✓	✓	

Notes

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2. N/A indicates districts, areas, or properties that are only identified by address. Noise analysis location number is indicated in brackets where applicable.
3. National Register of Historic Places (NR), State Register of Historic Places (LHD or SR), National Historic Landmark (NHL).
4. Area/property is partially (P) or completely (✓) within the 2012, 2020, or 2030 55 dB DNL contours. All historic resources listed are outside the 2012, 2020, and 2030 65 dB DNL contours.
5. Intersection that is located within 200 feet from historic district, area, or property.

G-5

All Historic Resources listed in the National and State Registers, and in the Inventory and MACRIS in Lincoln, reconnaissance survey area (projected 2030 55 dB DNL high growth noise contour or within 200 feet from a traffic study area intersection), 2012.

MHC Number	Historic Area/District ¹	Street Address	Historic Property ²	Date	National Register /State Register Status ³	55 dB DNL Contour ⁴			Intersection ⁵
						2012	2020	2030	
LIN.F	Minute Man National Historical Park	Route 2A	N/A	Multiple	NR NHL				TSA 6: Hanscom Drive & Route 2A
LIN.G	Minute Man National Historical Park	Route 2A	N/A	Multiple	NR NHL	P	P	P	TSA 6: Hanscom Drive & Route 2A
LIN.157	LIN.F/LIN.G Minute Man National Historical Park	165 North Great Rd	Giurleo House	1915	NR NHL				TSA 6: Hanscom Drive & Route 2A
LIN.158	LIN.F/LIN.G Minute Man National Historical Park	165 North Great Rd	Giurleo Garage	1915	NR NHL				TSA 6: Hanscom Drive & Route 2A

- Notes**
1. Historic district or area. Noise Analysis Location number is indicated in brackets where applicable. N/A indicates properties that are not located within a historic district or area.
 2. N/A indicates districts, areas, or properties that are only identified by address. Noise analysis location number is indicated in brackets where applicable.
 3. National Register of Historic Places (NR), State Register of Historic Places (LHD or SR), National Historic Landmark (NHL).
 4. Area/property is partially (P) or completely (✓) within the 2012, 2020, or 2030 55 dB DNL contours. All historic resources listed are outside the 2012, 2020, and 2030 65 dB DNL contours.
 5. Intersection that is located within 200 feet from historic district, area, or property.

Table G-6 Fifty Year Old Properties Surveyed in Hanscom Field, 2012

Town	Building Number	Building Name ¹	Date
Bedford	1	Hangar 1 - Signature Flight Services	1955
Bedford	2	Hangar 2 - Signature Flight Services	1955
Bedford	3	Hangar 3 - Signature Flight Services	1955
Concord	25	Draper Laboratory	1948
Lincoln	10	Hangar 10 - Vacant	1950s
Lincoln	12A	Hangar 12A – National Aviation Academy	1963
Lincoln	15	Civil Air Terminal	1953
Lincoln	16	Hangar 16 – Liberty Mutual	1940s
Lincoln	17	Hangar 2 - Jet Aviation	1954
Lincoln	20	Maintenance Building	1954

Notes: 1. Hangar 24 has been demolished since 2005.

Table G-7 Fifty Year Old Properties Surveyed at Hanscom Air Force Base, 2012

Town	Building Number ¹	Area Name ²	Street Address
Bedford	1614	Administrative Complex	11 Barksdale Street
	1639	Base Center	97 Barksdale Street
	1723	Hangars	25 Chennault Street
	1728	Hangars	29 Chennault Street
	1729	Hangars	51 Chennault Street
	1642	Base Center	70 Chennault Street
	1825	Civil Engineering	72 Dow Street
	1716	Hangars	115 Eglin Street
	1917	Civil Engineering	Grenier Street
	1646	Base Center	81 Grenier Street
	1813	Civil Engineering	119 Grenier Street
	1809/1810	Civil Engineering	120-131 Grenier Street
	1843	Civil Engineering	141 Grenier Street
	1425	Hospitality	60 Kirtland Street
	1427	Hospitality	75 Kirtland Street
	1426	Hospitality	85 Kirtland Street
Lexington	1302 D	Lincoln Labs	71 Schilling Circle
	1302 E	Lincoln Labs	75 Schilling Circle
	1302 F	Lincoln Labs	51 Schilling Circle
	Multiple	Air Force Cambridge Research Laboratory Historic District	Randolph Road, Grenier Street, Wright Street
Lincoln	1712	Hangars	6 Chennault Street
	1710	Hangars	9 Chennault Street
	1610	Administrative Complex	111 Eglin Street

Notes: 1. N/A – Not Applicable

2. Bedford Trailer Park (East and West Sections) in Bedford has been demolished since 2005. AFCRL Historic District is an update to the 2006 architectural survey. It was determined eligible (NRDOE) for National Register listing by the USAF and SHPO in 2012. It is in the Hanscom ESPR 2012 General Study Area, but is outside the 2030 55 dB DNL high growth noise contour.

Table G-8 Fifty Year Old Properties Surveyed in Bedford, Concord and Lexington, 2012

Town ¹	Area Name ²	Street Address	Category
Bedford ³	Hartwell Road	Beacon Street and Hartwell Road	Area
	Hartwell Road	9,11,12 Beacon Street	House
	N/A	336,340,427 Concord Road	House
	Hartwell Road	23,41,47,00 Hartwell Road	House
Concord	Carr Road	Carr Road	Area
	Walden Street	Walden Street	Area
	Carr Road	45,61,81,111,131-147 Carr Road	House
	N/A	531 Monument Street	House
	N/A	675 Monument Street	House
	N/A	676 Monument Street	House
	N/A	842 Monument Street	House
	N/A	873 Monument Street	House
	N/A	183 Virginia Road	House
	N/A	201 Virginia Road	House
	Walden Street	208,335,349,363 Walden Street	House, Barn
Lexington	Bedford Street	Bedford Street	Area
	East of Bedford St	Bertwell Road, Blake Road, Burlington Street, Crawford Road, Dee Road, Dexter Road, Eaton Road, Fuller Road, Gleason Street, Harding Road, Hillside Terrace, Nichols Road, North Hancock Street, Preston Road, Simonds Road, Williams Street, Wyman Road	Area
	Ivan Street	Bernard Street, Calvin Street, Donald Street, and Ivan Street	Area
	Meagherville Extension	Augustus Road, Hill Street, Kimball Road, Park Street, Reed Street, Sunny Knoll Road, and Vaille Avenue	Area
	Meagherville Extension	4 Augustus Road	House
	Bedford Street	197-419 Bedford Street	House
	East of Bedford St	8,12,18,19,20,26,31,37,42,43,44,51,65, 69,72,75,84,100,101,104,108 Bertwell Road	House
	East of Bedford St	00 Blake and Preston Road	House
	East of Bedford St	48,51,57,58,65,66,73,91,97,106,118,123 Blake Road	House
	Ivan Street	19,20,21 Bernard Street	House
	East of Bedford St	16,22,27,28,30,46,47,50,54,60,61,66,70,80 Burlington Street	House
	Ivan Street	6,7,9,10 Calvin Street	House
	East of Bedford St	7,9 Crawford Road	House
	East of Bedford St	7,8,11 Dee Road	House
	East of Bedford St	6,7,10,11,14,15,18,19,22,23, 33,35,51,52,53,57,58,62 Dexter Road	House

- Notes:**
1. Lincoln did not have any properties within the reconnaissance study area.
 2. Area is a neighborhood or district of multiple streets and/or structures. N/A – Not Applicable.
 3. The Bedford Trailer Park (East and West Sections) in Bedford has been demolished since 2005.

Table G-8 Fifty Year Old Properties Surveyed in Bedford, Concord and Lexington, 2012 (continued)

Town ¹	Area Name ²	Street Address	Category
Lexington	Ivan Street	12,14,22,24 Donald Street	House
	East of Bedford St	4,7,10,11,12,19,23,30,34,35,38 Eaton Road	House
	East of Bedford St	9,25,31 Fuller Road	House
	East of Bedford St	14,43,46,47,50,51,52,54,55,57,59,60,62,63,65,67,68,70,81,82,84,85,86,87,91,93,94,99,100,102 Gleason Street	House
	East of Bedford St	14,15,20,25,27,28,29,30,31,35,37,40,41,45,46,47,48,51,55,57,60,62 Harding Road	House
	Meagherville Extension	55 Hill Street (Lexington Golf Club)	Golf Course
	East of Bedford St	4,5,7,8,9 Hillside Terrace	House
	Ivan Street	10,21,25,28,29,30,32,33,36,40 Ivan Street	House
	Meagherville Extension	3,4,5,7,8 Kimball Road	House
	East of Bedford St	9 Nichols Road	House
	East of Bedford St	9,10,11,14,20,21,22,23,25,27,29,31,35,36,40,45,49,59,63,71,79,81,83,87,95,101,105 North Hancock Street	House
	Meagherville Extension	4,6 Park Street	House
	East of Bedford St	37,40 Preston Road	House
	Meagherville Extension	28,36,38,39,40,42,44,45,46,49,51,52,53,54,55,56,57,58,63,65,67,87,94,98,104 Reed Street	House
	East of Bedford St	20,31,32,36,44,53,54,70,74,75,78,82,88,91,95,100,103,104,105,107,109,127,135,138,144,152 Simonds Road	House
	Meagherville Extension	1,3,5,9 Sunny Knoll Road	House
	Meagherville Extension	6,10,16,17,20,21,24,26,32,35,36,37 Vaille Avenue	House
	East of Bedford St	20 Williams Street	House
	East of Bedford St	1 Wyman Road	House
	East of Bedford St	14,43,46,47,50,51,52,54,55,57,59,60,62,63,65,67,68,70,81,82,84,85,86,87,91,93,94,99,100,102 Gleason Street	House
	East of Bedford St	14,15,20,25,27,28,29,30,31,35,37,40,41,45,46,47,48,51,55,57,60,62 Harding Road	House
	Meagherville Extension	55 Hill Street (Lexington Golf Club)	Golf Course
	East of Bedford St	4,5,7,8,9 Hillside Terrace	House
	Ivan Street	10,21,25,28,29,30,32,33,36,40 Ivan Street	House
	Meagherville Extension	3,4,5,7,8 Kimball Road	House
	East of Bedford St	9 Nichols Road	House
	East of Bedford St	9,10,11,14,20,21,22,23,25,27,29,31,35,36,40,45,49,59,63,71,79,81,83,87,95,101,105 North Hancock Street	House
	Meagherville Extension	4,6 Park Street	House
	East of Bedford St	37,40 Preston Road	House
	Meagherville Extension	28,36,38,39,40,42,44,45,46,49,51,52,53,54,55,56,57,58,63,65,67,87,94,98,104 Reed Street	House

- Notes:**
1. Lincoln did not have any properties within the reconnaissance study area.
 2. Area is a neighborhood or district of multiple streets and/or structures. N/A – Not Applicable.
 3. The Bedford Trailer Park (East and West Sections) in Bedford has been demolished since 2005.

Table G-8 *Fifty Year Old Properties Surveyed in Bedford, Concord and Lexington, 2012*
(continued)

Town¹	Area Name²	Street Address	Category
Lexington	East of Bedford St	20,31,32,36,44,53,54,70,74,75,78,82,88,91,95,100,103,104,105,107,109 ,127,135,138,144,152 Simonds Road	House
	Meagherville Extension	1,3,5,9 Sunny Knoll Road	House
	Meagherville Extension	6,10,16,17,20,21,24,26,32,35,36,37 Vaille Avenue	House
	East of Bedford St	20 Williams Street	House
	East of Bedford St	1 Wyman Road	House

- Notes:**
1. Lincoln did not have any properties within the reconnaissance study area.
 2. Area is a neighborhood or district of multiple streets and/or structures. N/A – Not Applicable.
 3. The Bedford Trailer Park (East and West Sections) in Bedford has been demolished since 2005.

**Table G-9 Minute Man National Historical Park National Register District Data Sheet
Sorted Alphabetically by Town and Street Address**

C/NC ¹	NR CATEGORY	NPS NO.	MHC NO.	ADDRESS/LOCATION	NAME	DATES	STYLE
ALL TOWNS							
C	site	None			Battle of Lexington and Concord Battlefield	1775	n/a
C	structure	000919, 040170			Battle Road	18th through 20th centuries	n/a
NC	structure	None			Battle Road Trail	1996-2001	n/a
C	structure	Various			System of Stone Walls	18th through 20th centuries	n/a
C	site	None			System of Fields (Battle Road Unit)		n/a
CONCORD							
C ²	building	--	CON.256	448 Barrett's Mill Road	Col. James Barrett House	1705	Colonial
C	object	None		Estabrook and Liberty Street	Granite Mile Marker	early 20th century	n/a
C	object	None		Estabrook and Liberty Street	Granite Line of March Marker	early 20th century	n/a
C	object	040260		Estabrook and Liberty Street	John Buttrick Bas-Relief Monument	1915	n/a
C	structure	040255		Lexington Road	Meriam's Corner Area Stone Culvert	18th century	n/a
C	site	None		Lexington Road	(First) East Quarter School House Site	early 19th century	n/a
C	structure	040254		Lexington Road	Ox Pasture Stone Bridge	pre 1775	n/a
C	building	006549	CON.171	455 Lexington Road	Wayside (Samuel Whitney House)	1716-17; altered mid-1840s, 1860/70	Colonial/ Victorian Eclectic
C	site	None		455 Lexington Road	Wayside Site	19th century	n/a
C	site	040228, 040194, 040199, 040224		455 Lexington Road	Wayside Landscape	mid-1840s	n/a
C	building	000926		455 Lexington Road	Wayside Barn	1716-78; moved mid-1840s and 1860	No Style
C	site	012007		455 Lexington Road	Eliphelet Fox House Foundation	by 1666	n/a
C	building	006548	CON.349	663 Lexington Road	Gowing-Clark House	ca. 1836	Federal
C	site	040256		663 Lexington Road	Gowing-Clark Barn Foundation	19th century	n/a
C	building	040236	CON.352	737-739 Lexington Road	(Second) East Quarter Schoolhouse	ca. 1853-54	Frame Vernacular
C	building	4-119-B		750 Lexington Road	Palumbo Farm Enclosed Garage	ca. 1950	No Style
C	building	4-119-D		750 Lexington Road	Palumbo Farm Metal Shed	ca. 1950	No Style
C	building	4-119-C		750 Lexington Road	Palumbo Farm Open Shed	ca. 1950	No Style

Note: 1. Contributing/Non-Contributing

**Table G-9 Minute Man National Historical Park National Register District Data Sheet
Sorted Alphabetically by Town and Street Address (continued)**

C/NC ¹	NR CATEGORY	NPS NO.	MHC NO.	ADDRESS/LOCATION	NAME	DATES	STYLE
C	building	4-119-E		750 Lexington Road	Palumbo Farm Wood Shed	ca. 1950	No Style
C	building	040028	CON.354	831 Lexington Road	Perry House	ca. 1865; ca. 1880	Greek Revival
NC	building	4-103-B		831 Lexington Road	Perry House Garage	ca. 1960	No Style
NC	building	4-103-C		831 Lexington Road	Perry Shed	ca. 1960	No Style
C	building	040231, 040232	CON.355	851 Lexington Road	Albano House, Albano Garage/Apt.	1915	Craftsman
C	building	101972		851 Lexington Road	Albano Produce Stand	1915	No Style
C	site	040246		851 Lexington Road	Albano Foundation	20th century	n/a
C	building	023167	CON.356	955 Lexington Road	Farwell Jones House	pre 1775; remodeled ca. 1870	Frame Vernacular
C	building	040241		955 Lexington Road	Farwell Jones Dairy Barn and Silo	1870	No Style
C	building	4-101-D		955 Lexington Road	Edward Nowalk Garage	early 20th century	No Style
NC	building	4-101-C		955 Lexington Road	Edward Nowalk Produce Stand	ca. 1960	No Style
C	building	4-101-E		955 Lexington Road	Edward Nowalk 6-Bay Tractor Shed	early 20th century	No Style
C	building	4-101-F		955 Lexington Road	Edward Nowalk Cottage	early 20th century	No Style
C	building	023166	CON.357	965 Lexington Road	Olive Stow House	ca. 1760	Colonial
C	building	101975		965 Lexington Road	Olive Stow House Garage	ca. 1920	No Style
C	building	101976	CON.359	1087 Lexington Road	D. Inferrara House	ca. 1927	Colonial Revival
C	building	101977	CON.360	1087 Lexington Road	D. Inferrara Farm Stand	ca. 1920s	No Style
C	building	3-118-B		1087 Lexington Road	D. Inferrara Farm Garage	ca. 1937	No Style
NC	building	3-118-D		1087 Lexington Road	D. Inferrara Farm Coop	late 20th century	No Style
NC	building	3-118-F		1087 Lexington Road	D. Inferrara Farm Field Shed	late 20th century	No Style
NC	building	3-118-E		1087 Lexington Road	D. Inferrara Farm Greenhouse	late 20th century	No Style
C	building	101978		1133 Lexington Road	Walter Beatteay House	ca. 1940-1946	Colonial Revival
NC	building	3-126-B		1133 Lexington Road	Walter Beatteay Garage	ca. 1980	No Style
C	building	006547	CON.358	1175 Lexington Road	Samuel Brooks House	ca. 1692-1728	Colonial
C	object	006545	CON.941	Liberty Street	The Minuteman	1875	n/a
C	object	040266		Liberty Street	Muster Field Monument	early 20th century	n/a
C	site	000939		Liberty Street	Ephraim and Willard Buttrick House Site	1697-1700	n/a
C	structure	040250		Liberty Street	Flint Bridge	1877	n/a
C	site	None		Liberty Street	Jonas Bateman Site	18th century	n/a

Note: 1. Contributing/Non-Contributing

**Table G-9 Minute Man National Historical Park National Register District Data Sheet
Sorted Alphabetically by Town and Street Address (continued)**

C/NC ¹	NR CATEGORY	NPS NO.	MHC NO.	ADDRESS/LOCATION	NAME	DATES	STYLE
C	building	040024	CON.344	174 Liberty Street	Buttrick Mansion	1911	Classical Revival
C	building	040026	CON.346	174 Liberty Street	Buttrick Carriage House	1911	Colonial Revival
C	building	040025	CON.345	174 Liberty Street	Buttrick Caretaker's Cottage	1911	Colonial Revival
C	site	040183, 040182		174 Liberty Street	Buttrick Designed Landscape	early 20th century	n/a
C	site	014011		174 Liberty Street	Captain David Brown House Foundation	18th century	n/a
C	building	000932	CON.343	231 Liberty Street	Major John Buttrick House	ca. 1715; 19th-century alterations	Colonial
C	site	040249		231 Liberty Street	John Buttrick Foundation	19th century	n/a
C	building	040235		231 Liberty Street	Major John Buttrick Garage	early 20th century	Colonial Revival
NC	building	None		50 Manuel Drive	House	mid-late 20th century	Modern
NC	building	None		65 Manuel Drive	Korn House	ca. 1960	Modern Cape
NC	building	None		82 Manuel Drive	House	mid-late 20th century	Modern
NC	building	None		82 Manuel Drive	Shed	mid-late 20th century	No Style
NC	building	None		95 Manuel Drive	House	mid-late 20th century	Modern
NC	building	None		95 Manuel Drive	Garage	mid-late 20th century	No Style
C	object	006544		Monument Street	Grave and Monument to British Soldiers	1890-1910	n/a
NC	object	040262		Monument Street	DAR Marker	1975	n/a
C	object	006543	CON.939	Monument Street	1836 Battle Monument	1836	n/a
C	structure	000945	CON.940	Monument Street	North Bridge	1956	n/a
C	site	None	CON HA-13	Monument Street	Thomas Flint Site	after 1635	n/a
C	object	040261		Monument Street	Concord Fight Marker	early 20th century	n/a
NC	building	None		Monument Street	North Bridge Comfort Station	1984	No Style
C	structure	None		Monument Street	Road to North Bridge and Allée	early 20th century	n/a
C	building	000924	CON.348	242 Monument Street	Elisha Jones House	early 18th century; rebuilt 1865-66	Colonial
C	site	None		242 Monument Street	Elisha Jones Site		n/a
C	building	None	CON.347	269 Monument Street	Old Manse	1769/70	Colonial
C	site	None		North Bridge	North Bridge Landscape	1836-1956	n/a

Note: 1. Contributing/Non-Contributing

**Table G-9 Minute Man National Historical Park National Register District Data Sheet
Sorted Alphabetically by Town and Street Address (continued)**

C/NC ¹	NR CATEGORY	NPS NO.	MHC NO.	ADDRESS/LOCATION	NAME	DATES	STYLE
C	site	None		North Bridge	Battle Road/North Bridge Site	ca. 1635-1650	n/a
C	building	000928		North Great Road	Job Brooks House	1740	Colonial
C	object	040265		Old Bedford Road	Meriam's Corner Monument	1885	n/a
C	building	040243	CON.350	34 Old Bedford Road	Meriam House	ca. 1705, ca. 1725	Colonial
C	site	None		34 Old Bedford Road	John Meriam/Joseph Meriam House Sites	ca. 1665	n/a
C	building	040234	CON.351	55 Old Bedford Road	Burke House	ca. 1904	Dutch Colonial Revival
C	building	101974		55 Old Bedford Road	Burke House Garage	ca. 1940	No Style
LEXINGTON							
C	site	040253		Marrett Street	Tabitha Nelson House (Thomas Nelson, Sr.) Site	1754-57; 1716	n/a
C	building	000929	LEX.618	21 Marrett Street	Jacob Whittemore House	prior to 1754	Georgian/ Colonial
C	building	040239		21 Marrett Street	Barn at Whittemore House	19th century; moved 1978	No Style
C	site	None		Marrett Street	Jacob Whittemore Blacksmith Shop Site	18th century	n/a
C	site	None		Mass. Avenue and Marrett Street	Barn Foundation Site	1720-1900	n/a
C	site	None	LX HA-1	Mass. Avenue at Fiske Hill	Lt. David Fiske Site	1655-1721	n/a
NC	building	1-109-A		Massachusetts Avenue	Minute Man Visitors Center	1976	Modern
C	site	040247		Old Massachusetts Ave and Wood Street	Bashian Barn Foundation	1872-75	n/a
C	site	000923		Old Massachusetts Ave and Wood Street	Ebenezer Fiske House Foundation	ca. 1729-late 19th century	n/a
C	structure	006541		Old Massachusetts Ave and Wood Street	Fiske Hill Well	1700-75	n/a
C	object	040264		Old Massachusetts Ave and Wood Street	Hayward Well Monument	1885	n/a
C	object	040259		Old Massachusetts Ave and Wood Street	Bluff Monument	1885	n/a
C	site	None			Battle Road/ Fiske Hill Site	18th century	n/a
LINCOLN							
NC	building	2-129-A		58 Bedford Lane	Mrs. Edward Downing House	ca. 1954	Modern Cape
C	site	040248		Great North Road and Old Bedford Road	Thomas Brooks Farm Foundation	1800-50	n/a
C	site	040252		Massachusetts Ave. and Virginia Road	Samuel Hartwell Farm Cellar Hole	18th century	n/a

Note: 1. Contributing/Non-Contributing

**Table G-9 Minute Man National Historical Park National Register District Data Sheet
Sorted Alphabetically by Town and Street Address (continued)**

C/NC ¹	NR CATEGORY	NPS NO.	MHC NO.	ADDRESS/LOCATION	NAME	DATES	STYLE
C	site	040258		Massachusetts Avenue	Unidentified Cut Stone Foundation	early 19th century	n/a
NC	object	040267		Massachusetts Avenue	Paul Revere Capture Marker	pre 1902	n/a
NC	building	2-101-A		190 Massachusetts Avenue	Irene Hegenian House	1949-54	Modern Cape
NC	building	2-101-B		190 Massachusetts Avenue	Irene Hegenian Shed	ca. 1960	No Style
C	site	040027		Massachusetts Avenue	Josiah Nelson, Jr. Hop House Foundation	1810-1820	n/a
C	building	006551		200 Massachusetts Avenue	John Nelson House	1808-1810	Federal
C	building	012008		200 Massachusetts Avenue	John Nelson Barn	ca. 1810; additions 1830, 1900	No Style
C	site	None		Nelson Road	Site 22, 23	1700-1800; 1720-1800	n/a
C	site	None		Nelson Road	Daniel Brown House and Shop Site	18th century	n/a
C	site	000920		Nelson Road	Josiah Nelson House Foundation	ca. 1775	n/a
C	site	012006	LN HA-6	Nelson Road	Thomas Nelson, Jr. House Foundation	1700-1750	n/a
C	site	None		Nelson Road	Site 24	18th century	n/a
C	site	None		North Great Road	Hastings Barn Foundation	19th century	n/a
C	building	006546, 040233	LIN.64	33 North Great Road	Noah Brooks Tavern, Noah Brooks Tavern Carriage House	ca. 1798	Federal
C	building	040245		33 North Great Road	Noah Brooks Barn (Rogers Barn)	1937/38	No Style
C	site	None		North Great Road	Brooks House Site	18th century	n/a
C	building	006552	LIN.65	37 North Great Road	Joshua Brooks, Jr. House	1780	Federal
C	site	None		North Great Road	Joshua Brooks Tanyard Site	18th century	n/a
NC	building	3-111-A		59 North Great Road	Moodey House	1956	Dutch Colonial Revival
NC	building	None		71 North Great Road	Bierlich House	ca. 1957	Ranch
C	building	040244		101 North Great Road	Rego House	1890-1910	Frame Vernacular
NC	building	2-124-B		101 North Great Road	Rego House Garage	mid-late 20th century	No Style
NC	building	2-112-A		112 North Great Road	James Russell House	1954	Modern
NC	building	3-110-A		4 Old Bedford Road	W.R. Barker House	ca. 1940	Modern Cape
NC	building	3-110-B		4 Old Bedford Road	W.R. Barker Garage	1940-45	No Style

Note: 1. Contributing/Non-Contributing

**Table G-9 Minute Man National Historical Park National Register District Data Sheet
Sorted Alphabetically by Town and Street Address (continued)**

C/NC ¹	NR CATEGORY	NPS NO.	MHC NO.	ADDRESS/LOCATION	NAME	DATES	STYLE
NC	building	3-109-A		8 Old Bedford Road	Janet Swartz House	ca. 1955	Modern Cape
NC	building	3-109-B		8 Old Bedford Road	Janet Swartz Garage	ca. 1955	No Style
C	site	None		Virginia Road	Joseph Mason House Site	18th century	n/a
C	building	000931	LIN.66	Virginia Road	Ephraim Hartwell Tavern	ca. 1733	Colonial
C	site			Virginia Road	Ephraim Hartwell Site	18th century	n/a
C	building	006553	LIN.70	Virginia Road	Captain William Smith House	ca. 1750	Colonial
C	site	None		Virginia Road	Captain William Smith Site	18th century	n/a
C	site	000930	LIN.69	Virginia Road	Sgt. Samuel Hartwell House Site	1693-1716; burned 1968;shelter 1986	n/a
C	building	040029	LIN.140	Virginia Road	McHugh Barn	ca. 1830; rebuilt 1939	No Style

Notes: 1. Contributing/Non-Contributing
2. The Col. Barrett Farm Unit was added to the MMNHP in 2012, after the completion of the National Register nomination. It is assumed it would be contributing to an expanded nomination.